THE RELATIONSHIP OF STUDENT USE OF THE SCHOLASTIC *READABOUT* SOFTWARE SYSTEM ON TEXAS ASSESSMENT OF KNOWLEDGE AND SKILLS (TAKS) READING TEST SCORES AS REPORTED IN STUDENT RECORDS OF THIRD AND FOURTH GRADE STUDENTS AT COMAL INDEPENDENT SCHOOL DISTRICT, TEXAS

A Record of Study

by

ROSS MCCOWN MCGLOTHLIN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

August 2009

Major Subject: Educational Administration

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Approved by:

Co-Chairs of Committee,	Virginia Collier
	John Hoyle
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ABSTRACT

The Relationship of Student Use of the Scholastic *ReadAbout* Software System on Texas Assessment of Knowledge and Skills (TAKS) Reading Test Scores as Reported in Student Records of Third and Fourth Grade Students at Comal Independent School District, Texas. (August 2009)

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Dr. John Hoyle

The purpose of this study was to examine the effect of Scholastic, Incorporated's *ReadAbout* software system on student achievement in the subject of reading. The study assessed the relationship between the amount of time third and fourth grade students spent utilizing the program and their scale scores on the Texas Assessment of Knowledge and Skills (TAKS) reading test, as reported in student records of third and fourth graders at Comal Independent School District, Texas. Additionally, the study attempted to determine possible differences among students for the variables of gender, primary language of learning, and socio-economic status, as reported in student records of third and fourth graders at Comal Independent School District, Texas.

For the purpose of this study, school and student performance analysis included only the nine elementary schools in the Comal Independent School District that served third and fourth grade students during the 2007-2008 school year. The student

population under study consisted of a total of 585 third graders and 792 fourth graders (1377 total students).

The research findings of this study include the following:

1. There was a statistically significant relationship between the amount of time that both third grade and fourth grade students spent using the *ReadAbout* software system and their performance on the third and fourth grade TAKS reading tests.
2. No statistically significant relationships were determined for gender or socio-economic status when the amount of time individuals in each subpopulation spent using *ReadAbout* and the students' TAKS reading test scale scores were compared. However, in the analysis for primary language of learning, a small group of Spanish-speaking students who used *ReadAbout* for more than 16.5 hours prior to taking the test outperformed their English-speaking peers in the same usage category, and this difference did prove to be statistically significant.

DEDICATION

This work is dedicated to two special Texas public school educators – my mother, Elizabeth Claire McCown McGlothlin, and my late father, Ross Edgar McGlothlin, Jr.

My mother, an elementary school teacher and librarian who became a widow at the age of 44, worked hard to raise two good children who each chose careers in helping professions. The sacrifices she made, the example she set, and the love and support she provided made our personal, educational, and professional achievements possible. Thank you, mom. I love you.

My father, an intermediate school principal who still found time to be my little league baseball coach and take me camping, saltwater fishing, and arrowhead hunting, taught me so many life lessons in the 16 years we had together. Dad, this is also for you. I hope you have been able to see the direction my life has taken in these last 21 years, and I hope you are able to recognize your guiding influence in the man I have become.

ACKNOWLEDGEMENTS

There are many people I wish to acknowledge for their influence and support through the years. In general order of their appearance in my life, they follow:

Thank you to my sister and best friend, Emily Claire McGlothlin Maberry. I admire you for your big heart and your determination, and I love you very much.

Thank you to my aunts and uncles (Pat, Gloria, Andy, and Tanya McGlothlin), my surrogate parents (Pam and Joe Wiseman, John and Ouida Moore), and some dear friends of my family (Tana Clark, Barry and Shelly Beck, and Ivaleen Forren).

Patty Sylestine was my second grade teacher, and her stories of her son, Texas A&M basketball player Steven, led me to decide at age seven that I, too, needed to become an Aggie. Thanks, Mrs. Sylestine, for the introduction to Aggieland. My years spent living, laughing, and learning in College Station were some of the best of my life.

Ralph Parr was my high school principal, and he taught me firsthand the value of administrators building personal relationships and rapport with their students. Mr. Parr has maintained contact with me through the years, encouraging both my academic pursuits and my professional development. He occasionally offers me jobs for which I am not quite ready due to lack of experience. Thank you for your friendship and for your confidence in me.

David Ward was my seventh grade basketball coach, and he also coached me in the ninth and tenth grades. Señor Renfro, Nancy Gardner, James Robinson, and Kay Sue Lofland were four other special high school teachers of mine. It meant a lot that they

each took a personal interest in me when my dad was sick, and after he died. They kept me pointed in the right direction, fostering my development as an athlete, a scholar, and a gentleman. They made an impression on me that influenced my decision to become a teacher, as well.

Thank you, Bob Dylan. I discovered his early protest songs in my senior year of high school. They catalyzed my desire to help the “at-risk” and the disenfranchised.

Dr. Terry Anderson is a Professor of History at Texas A&M University. In the fall of 1990, when I was a homesick freshman in the Corps of Cadets with a shaved head and not enough time to sleep, I took his HIST 106 class. I failed the first exam (my first one to take in college) miserably. With two exams remaining and a huge hole out of which to dig, I approached him soon after on the walkway between the second floors of the Harrington Education Center and Harrington Tower. After naively addressing him as *Mr*. Anderson (and promptly being corrected), I told him that I was a history major taking my first history class and that I was scared because I didn’t think I knew how to study in college. He responded by flatly telling me, “Well, you know, college isn’t for everyone.” Whoa! However, he also offered to help me. A few days later, we met for 45 minutes in his office to review my class notes. He commented on them and also advised on how I should prepare for the next exam. Several weeks passed, and I took the second test. After they were graded and our scores were ready to be posted, he asked me to stand up among the nearly 300 students present. He proceeded to share that I had made a 92 on it – tied for the third highest score overall and the single greatest improvement from the first exam. Wow! The whole awkward learning and growing experience

propelled me through my undergraduate years; I took two more classes with Dr. Anderson, received a BA in History and teacher certification, and became an 8th grade American history teacher. I credit Dr. Anderson with not only being the most engaging teacher or professor I have ever had, but also with taking time to get an immature, ill-prepared, and generally clueless freshman on-track. I am honored to have him serve on this committee, nearly 19 years after he set me straight and showed me the way.

I would also like to acknowledge the late Dr. Gonzalo Garcia, Jr., formerly of Texas A&M University, and Dr. Stanley Schainker of the University of North Carolina at Chapel Hill. These professors stimulated thinking in me during graduate school that significantly expanded my perspective. Dr. Garcia was a kind and gentle man and an exceptional teacher. I regret that he did not live long enough to serve on this committee. Dr. Schainker is the most brilliant, insightful, and pragmatic educational leader I have ever met. I regularly reference the lessons I learned in his classes and apply them today.

A special thank you also goes to the three best bosses I have ever had – Dr. Lolly Guerra, Dr. Dana Bashara, and Dr. Victoria Pursch, each products of this doctoral program. Upon my return to Texas, during five formative years from 2002-2007, the east coast theories I learned in graduate school were shaped into Texas practice through the guidance and support of these ladies. You each made me better; I appreciate you for that.

Finally, thank you to my next-door neighbor, Dr. Lynn Matherne, my student drop-off line drive-by morning mentor, Dr. Johnnie Rosenauer, my current Superintendent, Dr. Marc Walker, my committee members, and especially to my Co-Chairs, Dr. Virginia Collier and Dr. John Hoyle. You each either coached me, prodded me, built me up, or reminded me that I could do it. I am grateful, and I will pass along the same support to future doctoral students who will follow us, expanding the base of knowledge in our field.

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CHAPTER I

INTRODUCTION

Society is becoming more dependent upon technology use with each passing year. Since the establishment of personal computers into the fabric of our culture in the early 1980s, we have become quite dependant upon, and even respectful, of them. *Time* magazine went so far as to name the personal computer its "Man of the Year" in 1983 (Robertson, 2003). During the decade of the 1990s, criticism of failing school systems characterized the debate on public education, and this was perhaps most strikingly exposed by Jonathan Kozol (1991) in his disturbing book, *Savage Inequalities*. The propagation of computer technology was another characteristic of the decade. Many invested parties began to believe that education could be transformed through the use of technology and that student achievement would naturally increase as a result (Herman, 1994).

Technology's integration into our daily lives has transcended original computation and organization applications. In the early 1990s, the most common use of technology in schools had been to support general task-, skill-, and fact-oriented instruction and as a means to supplement work after more traditional instruction had already taken place. Early computer applications encouraged students to excel at a repetitive task, learning the workings of a software program or developing automaticity (Becker, 1994).

The style for this Record of Study follows that of *The Journal of Educational Research*.

Predictably, as personal computers became more readily available to individuals within our society in the mid-1990s, school systems began to provide students and teachers access to computers, as well (Noble, 1996). State school systems and the United States Department of Education have allocated millions of dollars for computer technology in the hopes of improving teacher instruction and student learning. Towards the end of the decade in 1998, it was estimated that the K-12 system spent $7.2 billion on technology (Anderson & Becker, 2001). The importance of integrating technology continues to gain momentum as society moves away from an economy based on industrialization and towards dependence upon the ability to access information (Otero & Peressini, 2005).

Though technology use in the classroom is growing, there is a need for more research that ties computer access and use to higher student achievement (Cuban, 2001; Whitehead, Jensen, & Boschee, 2003). “Performativity,” a term coined by Jean-François Lyotard (1984), has been used to describe the way that anything at all becomes legitimate if it works – a more modern version of Machiavelli’s assertion that ends justify means. With this concept of performativity in mind, measurable student performance becomes an end in itself. As such, claims can be made by educational technology proponents that student success on accountability measurements such as the Texas Assessment of Knowledge and Skills (TAKS) can rightfully be attributed to the use of engaging computer software such as Scholastic, Incorporated’s *ReadAbout* program.

As the effort to address minority student achievement and close the achievement gap between students of color and their White peers gains national momentum, it is natural that educators look to use technology in the classroom to assist in this effort. DiCinto and Gee (1999) assert that students who have not experienced academic success are sometimes not motivated to achieve because the lessons they are presented are not meaningful to their own lives and interests. According to many, the classroom use of technology has the potential to engage at-risk students (Dunkel, 1990; Means & Knapp, 1991; Merino, Legaretta, Choughran, & Hoskins, 1990). When teachers present material to at-risk students in a way that is aligned with their students' own styles of communication and learning, there is great potential for student success (Roschelle, Pea, Hoadley, Gordin, & Means, 2000).

Continued research on the effective and efficient use of technology has the potential to contribute in a positive way by informing educators of opportunities to make learning more engaging for students, thus increasing student achievement (Brockmeier, Sermon, & Hope, 2005).

Statement of the Problem

To what degree does technology use promote student achievement? A licensing agreement for Scholastic's *ReadAbout* system was made by the Comal Independent School District in 2006. The program was purchased by the district with the intent of supplementing reading instruction in grades 3-8. The district justified the purchase by stating its intended purpose – early intervention for students in the subject of reading. District administrators were aware of the difficulty that many intermediate (third through fifth) grade students have in transitioning from “learning to read” (letter and sound identification; simple “decoding” of text) to “reading to learn” (comprehension; development of vocabulary and content-area knowledge). It could be expected that if students were provided an engaging, effective, supplemental way to develop these skills, they would perform well on their Texas Assessment of Knowledge and Skills (TAKS) tests, thus justifying the cost of the program.

Is Scholastic’s *ReadAbout* system effective? Moderate gains have been reported in research on the effective classroom use of technology in some case, while other research has shown no gains at all (Schacter, 2001; Sivin-Kachala & Bialo, 1999). Data are used to drive instructional decisions in schools across the country; data are also used to make fiscal decisions regarding supplemental, instructional resources. An issue this practical research attempted to resolve is whether this program is cost-effective. It will tie the amount of time that 1,377 Comal Independent School District third and fourth grade students spent utilizing the *ReadAbout* system during the 2007-2008 school year prior to their 2008 TAKS reading test dates with their scale scores on these tests. The research attempted to determine whether there is a correlation between minutes spent on the *ReadAbout* system and student achievement as defined by reading scores on the State of Texas’ standardized, end-of-grade tests.

Can school administrators benefit from research on the effectiveness of computer software programs that purport to increase student achievement? Research tells us that schools with high percentages of students who are considered of low socioeconomic status (and thus at risk of not demonstrating academic proficiency) are often led by administrators who display low levels of understanding for how technology can be used to bolster instruction (Anderson & Dexter, 2005). This study intends to produce findings that will be beneficial to the school leaders who must make programmatic decisions that will lead to positive student outcomes.

Purpose of the Study

In this study, the relationship of student use of the *ReadAbout* system was compared with Texas Assessment of Academic Skills (TAKS) reading test scores of third and fourth graders in the Comal Independent School District in Bexar and Comal County, Texas. The study assessed any relationship that may exist between the amount of time the students spent using the *ReadAbout* program during the 2007-2008 school year prior to their testing dates and their scores on the 2008 TAKS reading test. In addition, the study analyzed differences among selected demographic variables as reported in student records at Comal Independent School District, Texas.

Research Questions

This study was guided by the following research questions:

1. Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008 school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported in student records at Comal Independent School District, Texas?
2. Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008

school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported for selected student demographic variables in student records at Comal Independent School District, Texas?

Operational Definitions

The findings of this study were reviewed within the context of the following definitions of operational terminology:

Academic Excellence Indicator System (AEIS): This statewide system database compiles information regarding the broad operations and achievements of all Texas state independent school districts and their representative campuses. The AEIS database includes quantitative reporting on student performance from the Public Education Information Management System (PEIMS).

"At-Risk": According to the Texas Education Code, Section 29.081, a student is considered at risk of dropping out of high school if he/she meets one of 13 criteria that have been established by the state. Among these criteria, being retained in a grade level, being homeless, and being a student of limited English proficiency each qualify a student for this designation, among other reasons.

Bilingual: Bilingual means of, involving, or using two languages.

Demographic Variables: Ethnicity, gender, economically disadvantaged status, limited English proficient status, and campus of enrollment are demographic variables.

Economically Disadvantaged: A student is identified as economically disadvantaged by an independent school district if he/she is eligible for free or reduced-price lunch, meet requirements for Title II of the Job Training Partnership Act (JPTA), receive food stamp benefits, or qualify for other public assistance. In addition, if the student is under the parental or custodial care of a family with an annual income at or below the official federal poverty line, regardless of public assistance, they too can be identified as economically disadvantaged.

Limited English Proficient: According to the Texas Education Code, Section 29.052, a limited English proficient student is one whose primary language is other than English and whose English language skills are such that the student has difficulty performing ordinary classwork in English.

Predictor: A predictor is an item from which one may state, tell about, or make known in advance.

Public Education Information Management System (PEIMS): A statewide data management system for public education information in the state of Texas. For the purpose of this study, the major categories reported by the PEIMS report include student demographic and program participation data.

ReadAbout: A multi-leveled, content-area software program that has been designed for the purpose of helping students in grades 3-8 build vocabulary and reading comprehension skills and strategies. The program is interactive and of high interest to young people. A database supports the system, and it is through this database that students receive differentiated instruction according to his or her individual needs. Teachers and administrators may use the database to monitor the amount of time students spend using the program and their success rate on the questions presented.

Relationship: A connection between a dependant and an independent variable as determined by a given statistical test is a relationship.

Success: Success is a result or outcome.

Texas Assessment of Knowledge and Skills (TAKS): The TAKS measures student mastery of the Texas Essential Knowledge and Skills (TEKS), the statewide curriculum, in reading at Grades 3-9; in writing at Grades 4 and 7; in English language arts at Grades 10 and 11; in mathematics at Grades 3-11; in science at Grades, 5, 10, and 11; and in social studies at Grades 8, 10, and 11. The Spanish TAKS is administered at Grades 3-6. Satisfactory performance on the TAKS at Grade 11 is prerequisite to a high school diploma.

Texas Education Agency (TEA): The TEA is comprised of the commissioner of education and agency staff. The TEA and the State Board of Education (SBOE) guide and monitor activities and programs related to public education in Texas. The SBOE consists of 15 elected members representing different regions. One member is appointed chair by the governor. Under the leadership of the commissioner of education, the TEA administers the statewide assessment program, maintains a data collection system on public schools for a variety of purposes, and operates research and information programs among numerous other duties. The TEA operational costs are supported by both state and federal funds.

Assumptions

1. Interpretation of the data collected accurately reflects the amount of time Comal Independent School District third and fourth grade students spent using the *ReadAbout* program and their achievement on the third and fourth grade TAKS reading test.
2. The methodology proposed and described here offers a logical and appropriate design for this particular research project.

Limitations

1. The study was limited to a select number of third and fourth grade students at Comal Independent School District, Texas.
2. The study was limited to the information acquired from the review of the literature, student use of the *ReadAbout* program during the 2007-2008 school year prior to their 2008 TAKS reading test dates, and achievement data as determined by the students' scale scores on the 2008 TAKS reading test.
3. Findings were generalized only to one school district: Comal Independent School District, Texas.

Methodology

The findings of this study were ascertained through the following methods conducting research:

Population

For the purposes of this study, student performance analysis included only the third and fourth grade students from Bill Brown Elementary School, Comal Elementary School, Freiheit Elementary School, Goodwin-Frazier Elementary School, Hoffman Lane Elementary School, Rahe Bulverde Elementary School, Rebecca Creek Elementary School, M. H. Specht Elementary School, and Startzville Elementary School in the Comal Independent School District, Bexar and Comal County, Texas, who used the ReadAbout program during the 2007-2008 school year. A total of approximately 600 third grade students and 800 fourth grade students made up the population under study.

Instrumentation

The data collected for the purposes of this study were derived from the database of the Scholastic *ReadAbout* software system and from student performance data on the 2008 third and fourth grade TAKS reading test.

With the permission of the Comal Independent School District, data regarding students' usage of the *ReadAbout* system collected during the 2007-2008 school year was compared with student success rates on the 2008 third grade TAKS reading test. Comal Independent School District provided the results. The results were reported as a scale score for each student. Each student's name and student identification number remained unpublished and confidential.

Procedures

The researcher collected data on third and fourth grade student usage of the *ReadAbout* system from Bill Brown Elementary, Comal Elementary, Freiheit

Elementary, Goodwin-Frazier Elementary, Hoffman Lane Elementary, Rahe Bulverde Elementary, Rebecca Creek Elementary, M. H. Specht Elementary, and Startzville Elementary for the 2007-2008 school year. Additionally, the researcher collected student scale scores from the 2008 TAKS reading test for those students. Student demographic data were also recorded.

Data Analysis

The results of the study were reported using appropriate quantitative techniques outlined in *Educational Research: An Introduction* by Gall, Borg, and Gall (1996). The data were analyzed using version 11/5/1 of the Statistical Package for Social Studies (SPSS), a statistical analysis software program. Several statistical procedures were used to answer research questions that determine the relationship between student usage of the *ReadAbout* system and these same students' performance on the 2008 TAKS reading test. The researcher also tested for significant differences between selected demographic variables. The researcher used mean scores, standard deviations, frequencies, and correlations as part of the descriptive analysis. Multiple displays such as charts and tables were used to present findings.

Significance of the Study

This study explored the relationship of student usage of the *ReadAbout* system and student success rates on the 2008 third and fourth grade TAKS reading test. It also determined whether the *ReadAbout* system is a more effective educational tool for students in particular demographic groups than in others.

Because the Comal Independent School District has invested more that $1 million in the Scholastic, Incorporated *ReadAbout* system, this practitioner believes that the study will hold significance for the school district as a way to determine the overall returns on its investment. The research will also prove helpful to school administrators in the Comal Independent School District as a way to determine if there are particular sub-populations for which the computer software system is especially effective.

CHAPTER II

REVIEW OF THE LITERATURE

Preface

This review of the literature will cover five topics. The first section establishes the historical context of technology use in our society and the ways that personal computers and related technology began to be used in public school systems across the United States nearly 30 years ago. The intended purpose is to explain this evolution to education policy makers and to provide examples of early technology that have the potential to influence future decisions. In the second section, research on student technology use, conducted over the last several years, is shared. This research supports the claim that technology has the power to enhance student learning for a variety of subjects, including mathematics and reading/language arts. The third section documents critiques of student technology use, and it explains this era of "technopositivism," (Roszac, 1994) during which many have begun to see computer-assisted instruction as a "silver bullet" for any and all challenges educators face. The fourth section is dedicated to technology use among groups of students who are considered at-risk of not graduating from high school, such as students who experience poverty and English language learners. The fifth section frames this Record of Study by explaining the process of learning to read and also by identifying aspects of the process that are difficult for some. "Best practices" for reading instruction are also discussed, ultimately linking the use of educational software with increasing student achievement in reading, which is the subject of this research.

The Historical Context of Technology Use in Society and in the Classroom

The world is becoming more dependent upon technology use with each passing year, yet a little more than one-quarter of one century ago, most Americans could not have dreamed of the myriad daily uses of technologies that influence our lives today. In the first week of January 1983, *Time* magazine recognized the personal computer as its "Man of the Year" (Friedrich, 1983), signifying an early respect for its immediate impact on our society and suggesting a bright future. Friedrich wrote:

> The "information revolution" that futurists have long predicted has arrived, bringing with it the promise of dramatic changes in the way people live and work, perhaps even in the way they think. America will never be the same. In a larger perspective, the entire world will never be the same. (p. 2)

In the same decade, criticism of failing school systems characterized the debate on public education, and this was perhaps most strikingly chronicled by Kozol (1991) in his landmark book, *Savage Inequalities*. Many vested parties began to believe that education could be transformed through the use of technology and that student achievement would naturally increase as a result (Campoy, 1992; Herman, 1994). In response to the general criticism of public schools and to the National Commission on Excellence in Education's somewhat apocalyptic and widely-publicized critique of the public school system, *A Nation at Risk: The Imperative for Educational Reform*, the introduction of computer technology into American classrooms followed (Robertson, 2003). Predictably, as personal computers became more affordable and readily available to individuals in the 1990s, school systems began to provide students and teachers access to computers (Noble, 1996).

In the roughly 30 years technology has been available to public school students, this review of the literature has identified at least two distinct eras of usage. In the 1980s and early- to mid-1990s, due in part to the limitations of the technology available at the time, computers were most commonly used to support general task-, skill-, and fact-oriented, repetitive instruction (Means, 2000) and as a way to supplement classwork after more traditional instruction had already taken place (Becker, 1994). It is offered as a reminder that in the early days of the educational technology movement, much time and effort was spent introducing students to the basics of how to simply use a computer (Means, 2000; Valmont, 2000). The next generation of educational technology has proven to be much more advanced. The corresponding, updated applications will be reviewed in the following pages.

The "Digital Divide": Access Equity in the Early Years

For many years, it was believed that if students merely had home and school access to computers, their learning would be appropriately supported. It was reported that the access inequities that did exist among students of different socioeconomic backgrounds had created a "Digital Divide" for our nation's young people (Chen & Price, 2006; Warschauer, Knobel, & Stone, 2004). This perception of unequal access led to a proliferation of instructional technology in schools, and from 1983-1995, the national average of computers per student dropped significantly, from 125 students per computer to just 9 students per computer (Glennan & Melmed, 1996).

Biannual research studies conducted by the National Telecommunications and Information Administration (NTIA) have continued to focus on the issue of access, and though inequities still exist, steady progress is being made (NTIA, 2000, 2002, 2004). Other research corroborated this assertion, as well. A narrowing of the access gap for economically disadvantaged and ethnically diverse schools was observed in such specific areas as the average number of students per multimedia computer, the average number of students per networked computer, schools with high-speed Internet access, and schools with laptop computer programs (Kleiner & Farris, 2002).

However, research suggested that simply having access to a computer at home and at school does not level other imbalances and biases, including those of high expectations for all students. For example, among all students with home computers, wealthy students were much more likely to complete homework assignments using them than were poor students. In addition, teachers of high-socioeconomic status students were also more likely to assign technology-based homework assignments because they expected that their students would have access to computers in their homes (Becker, 2000).

In the introduction to a 2001 *Education Week* special issue titled, *Technology Counts*, a more complex explanation for the problem than the simple access issue, which was beginning to disappear, was provided:

> Inequalities in the availability of computer technology and Internet access still exist. But rather than one single, gaping divide, what the nation's schools are grappling with is more a set of divides, cutting in different directions like the tributaries of a river. And increasingly, those inequalities involve not so much access to computers, but the way computers are used to educate children. ("Dividing lines," 2001, pp. 10-11)

Current Uses – The Transformation of Educational Technology

Continued research on the effective and efficient use of technology has potential to contribute in a positive way by informing educators of opportunities to make learning more engaging for students, thus increasing student achievement (Brockmeier et al., 2005). Ferdig (2006) encouraged educators to use technology to reach students' "Zone of Proximal Development" (Vygotsky, 1978) so that the applications used are neither too simple for the students, causing them to get bored, nor too difficult, leading them toward frustration, dissatisfaction, and annoyance.

Over time, as computers have become faster and their information-storing capacity has increased, educational technology has been catapulted into the modern era. Through the use of "smart" programs, known as discrete educational software (DES), Murphy et al. (2002) explained that educators began understanding computers

> as a *medium* for learning, rather than simply as a tool to be mastered that could then support further learning…the unique ways that the software affords to support learning – the kinds of problems students are presented, how students approach them, and the strategies students devise to achieve their own goals in using the software – are believed to be the most significant factor in determining the effective use of discrete educational software. (p. 9)

Teachers could *introduce* lessons in new and exciting ways, *supplement* their instruction (or *supplant* it altogether), differentiate more easily, and *make new learning opportunities available* through the unique features of most DES (Murphy et al., 2002, p. 11).

Current software capabilities have significantly expanded the uses of technology in the classroom. The diagnostic component of most software can adapt the level of instruction to the individual needs of each student, identify the specific objectives on which students struggle, provide teachers with suggestions for tutoring, and even document students' cognitive process step-by-step, providing remediation at the moment it becomes necessary (Cradler, McNabb, Freeman, & Burchett, 2002; Murphy et al., 2002; Viadero, 2007).

Others focus on the possibilities of *what* students learn by citing innovative ways students can now, through technology use, be exposed to new ideas and concepts that they would otherwise not be able to access. For example, students can learn to compose music using a synthesizer program despite not knowing how to play an instrument, or monitor the findings of an ongoing archeological dig in southern Mexico despite not having the ability to travel there, or dissect a "virtual" frog in an online laboratory without ever holding a scalpel (Cavanagh, 2008; Davis, 2007; Roschelle et al., 2000).

Perhaps most encouraging is the research that demonstrated the degree to which today's students are engaged by the "holding power" of educational technology (Turkle, 1995). Smith and Wilhelm (2002) reported in their aptly titled book, *Reading Don't Fix No Chevys: Literacy in the Lives of Young Men*, that males' preferences in reading were more geared toward material that was deemed practical rather than academic and that they tended to be drawn to reading activities that involved the use of technology rather than traditional methods.

The Politics and Economics of Educational Technology Use

Support for technology use in classrooms has radiated from the schoolhouse and entered the statehouse as legislators have recognized the economic necessity of training K-12 students to enter the highly-skilled workforce of tomorrow (Cavanagh, 2008), harkening to the apocalyptic messages contained in the National Commission on Excellence in Education's (1983) *A Nation at Risk*. Throughout the early years and into this next generation, state education agencies and the federal Department of Education have allocated billions of dollars for computer technology with the goal of improving teacher instruction and student learning. Toward the end of the decade, in 1998, it was estimated that the national K-12 school system spent $7.2 billion on technology in that single year alone (Anderson & Becker, 2001).

Efforts to integrate technology continue as the global economy becomes less dependant upon industrialization and more oriented toward information access (Otero & Peressini, 2005). For example, state-of-the-art technology is increasingly more accessible to students in hopes of improving achievement in an identifier becoming collectively known as STEM (Science, Technology, Engineering, and Mathematics). Technology is being recognized as the medium that will drive advances in these fields and spur economic growth. State legislators have been supportive of these efforts because they have recognized that by providing funding for technology that supports innovative learning opportunities, they are investing in their states' economic future (Cavanagh, 2008).

As another example of the influence of state government on technology use, the Editorial Projects in Education (EPE) Research Center determined that 48 state education agencies presently include technology in their standards for students, and five states test students' level of proficiency. Forty-four states include technology in teachers' standards, and 35 states require the same of their administrators (EPE Research Center, 2008).

In 2007, the International Society for Technology in Education (ISTE) updated its set of standards for student technology use. The standards cover six areas: Creativity and Innovation; Communication and Collaboration; Research and Information Fluency; Critical Thinking, Problem Solving, and Decision Making; Digital Citizenship; and Technology Operations and Concepts. These standards were markedly different from the previous set, published in 1998, and the change seemed to reflect a more progressive understanding of this rapidly changing field. Don Knezek, Chief Executive Officer of ISTE, wrote, "In 1998, it was enough to define what students needed to know about and be able to do with technology. Now, we're defining what students need to know and do with technology to learn effectively and live productively in a rapidly changing digital world" (ISTE, 2007).

To be sure, there has been an explosion in educational technology use since the debut of the personal computer in the early 1980s, and the field continues to expand at a dizzying pace. The critical question is whether or not the use of computers has increased student achievement.

Research on the Use of Software to Support Student Learning

Students are increasingly being required not only to learn, "The Three Rs" (reading, writing, and arithmetic), the most basic of skills taught in our nation's public schools since their inception, but to also adapt to the evolved requirements of this digital and networked Age of Technology, referred to as, "The Four Es" – Exposing

Knowledge, Employing Information, Expressing Ideas Compellingly, and Ethics on the Internet (Warlick, 2004, 2005) (Figure 2.1).

Exposing Knowledge (Reading) *"accessing"*	Employing Information (Arithmetic) *"processing"*
• Find relevant information within the 21st Century library – The World Wide Web. • Understand and explain what has been found, regardless of format (e.g., text, images, audio, or video). • Evaluate the electronic information to determine its accuracy and its worth. • Organize that information into electronic folders or other personal e-libraries.	• Extend digital applications beyond simple computation and measurement. • Understand how to employ numbers in a practical way to answer important questions, solve actual problems, and accomplish personal goals. • Use spreadsheets and data-processing tools to organize and categorize digital information, and make it available for easy access.
Expressing Ideas Compellingly (Writing) *"communicating"*	Ethics on the Internet
• Write convincingly and effectively. • Communicate with images and audio, as well as the written word. • Produce an accurate, effective, creative message that will capture their audience's attention. • Incorporate images, sound, animation, and video-basics for contemporary literacy.	• Use the Internet responsibly to access research and other information. • Learn to abstain from ethical pitfalls, such as plagiarism and inappropriate computer use. • Respect the accuracy of information; be mindful of reliability and bias. • Credit the owners and creators of the knowledge and information appropriately.

Figure 2.1. Warlick's explanation of what students must be able to accomplish using "The Four Es."

Traditional reading opportunities are increasing to include sources of information that grow on a weekly basis in both scope and depth; traditional mathematics has expanded to include complex, digitalized information, never before accessible to the public, and emerging, techno-savvy generations seek new ways to express knowledge, opinions, and creativity (Warlick, 2005). This is reflected in Figure 2.1

A number of studies have attempted to measure the effectiveness of technology use on student performance (National Institute of Child Health and Human Development

[NICHD], 2000). A statistical technique known as “meta-analysis” (Glass, McGraw, & Smith, 1981), which allows researchers to fuse the findings of multiple studies, was used to analyze educational technology efficacy during a ten-year period from the mid-1980s to mid-1990s. To summarize the collective findings, the researchers generally concluded that elementary and middle school students learned more when information was presented through these early, simple offerings of computer-based instruction, and they did so in less time, with more positive feelings about their learning experiences (Bangert-Drowns, Kulik, & Kulik, 1985; Kulik, 1994; Kulik & Kulik, 1991; Ryan, as cited in Murphy et al., 2002).

Technology Usage in Support of Elementary Mathematics and Science

Specific to the subject of mathematics for elementary age students, Elliot and Hall (1997) worked with a group of 54 Australian pre-kindergarten students who were considered at-risk for early learning difficulties. These students were placed into three groups. Two of the groups used computer technology to bolster their skills in mathematics, and the third group received math instruction that was not technology-based. The groups of students who used the software to develop their math skills scored considerably higher on the Test of Early Mathematical Ability – TEMA 2 – than the group that did not use technology.

In another study, third and fifth grade students received either computer-assisted instruction (CAI) in mathematics or traditional math instruction for 71 days. Students in both grade levels who received the computer instruction scored higher on a exam of basic math concepts than their peers who received only teacher-driven instruction (Fletcher, Hawley, & Piele, 1999).

The longitudinal impact of classroom computer usage on math achievement in middleclass second graders has also been studied. One group used technology applications since kindergarten to supplement their instruction, and the other group did not. The students who used computer-assisted instruction outperformed the control group in problem-solving ability (Stone, 1996). A separate study on fourth graders' use of math software programs produced similar results (Wenglinsky, 1998).

In a comparative study of the impact of technology use on math and science achievement in third graders, one group was instructed using "hands-on" meteorology experiments and a supplemental software program, the second group only participated in the "hand on" experiments, and the third group was taught by traditional means. The first group did better on a post-test than the second group, and both of these groups outperformed the group that only received the traditional instruction (Gardner, Simmons, & Simpson, 1992).

Technology Usage in Support of Elementary Reading

For the subject of reading, research is sparse, and it tends to be limited to students' use of early, simple software programs (Murphy et al., 2002). Researchers found that between 1986 and 1996, only 350 scholarly reports on computer use for reading instruction were published, representing between 2% to 5% of the total number of research studies on reading conducted during that span (Kamil & Lane, 1998).

In 2000, the National Reading Panel published its report on the efficacy of technology use for reading instruction. It, too, noted a dearth of work on the subject and surmised that reading researchers might not have accepted the legitimacy of technology, and, therefore, not researched it. The panel reported the widely-held belief within the literacy community that reading is an art form that only humans can deliver, and because computers were not capable of adjusting to the subtleties of oral reading, they had to be relegated to an instructional support role (NICHD, 2000). Despite these obstacles, some research has emerged.

In a meta-analysis examining the effect of computer-assisted instruction (CAI) programs on reading achievement for primary grade students, 42 studies from as early as 1990 onward determined that the corrected overall effect size was .19, meaning that the CAI had small, though positive effects (Blok, Oostdam, Otter, & Overmaat, 2002).

In a 1996 study of 30 first graders, the children had access to a computer system for reading that provided prerecorded prompts for unknown words upon request. The 30 first graders who used the system recorded significantly higher gains than the control group, and the amount of time the experimental group used the system correlated with their gains (Davidson, Elcock, & Noyes, 1996).

Researchers attributed gains in phonemic awareness made by another group of 54 first graders to their ability to revisit instructional samples as many times as necessary, and thus found that software programs with such features did improve student achievement in reading. The students, each of whom was considered at-risk, received 25 minutes of computer-assisted instruction two times per day, four days per week. The control group spent equal time working on math software. The children in the experimental group outperformed their classmates on measures of phonemic awareness by a significant margin (Barker & Torgesen, 1995).

In another study, first graders in two suburban school systems in California and Massachusetts and one urban system in Massachusetts used interactive storybooks for three months to support reading, writing, speaking, and listening in addition to receiving standard, teacher-directed instruction. The control groups for the study received only teacher-directed literacy instruction. The experimental group established an increase in basic language skills (Schultz, 1995).

Research studies on the student use of reading software programs such as "electronic books," an interactive format for reading on the computer, have established a positive effect on the vocabulary development and comprehension skills of very young readers. This particular DES provides comprehension cues, allows children to easily re-read passages if necessary, adds more context to passages than traditional texts, and when activated, models fluent reading, as well (Horney & Anderson-Inman, 1999; Lefever-Davis & Pearman, 2005).

Technology Usage in Support of Other Academic Subjects

A number of meta-analytic studies conducted over the course of the last ten years have addressed specific aspects of computer usage as a learning tool for other topics and subjects, as well. Interactive distance learning (Cavanaugh, 2001), CAI in science instruction (Bayraktar, 2001-2002), instructional simulations using technology (Lee, 1999), general, microcomputer-based CAI in a variety of subject areas (Christmann, Badgett, & Lucking, 1997), and differences in attitudes and behaviors among technology-using students of differing genders (Whitley, 1997) have all been examined. In each case, a small but positive effect with the experimental group was reported.

The Roles of Educators in Determining Effective Ways to Use Technology

Teachers and administrators have critically important roles in determining how to *effectively* integrate technology that benefits students, and decisions must be based on a clear conceptualization of how it can best be done (Brockmeier et al., 2005). As he reported the results of his findings, Haugland (1992) surmised that, “like crayons, blocks or any other learning resource we provide young children, computers are neither good nor bad. The effect of computers depends upon…the wisdom of adults to make wise choices regarding appropriate experiences for young children” (p. 28).

In order to determine effective student use, educators must themselves be efficient technology users. Several research studies tie student and teacher technological ability, utilization, and achievement together; the more proficient the teacher at integrating technology in meaningful ways, the more able the student will be to learn from it (Bransford, Brown, & Cocking, 1999; Otero & Peressini 2005; Sandholtz, 2001).

A 1998 survey of more than 4,000 teachers identified factors that affected classroom technology use. Teachers perceived that the location and number of accessible computers, the teacher’s own knowledge of computers, the pedagogical philosophy of the teacher, and the school culture had the greatest effect (Roschelle et al., 2000).

In a meta-analysis of studies on elementary school computer use from the early years of the technology movement, variables such as characteristics of students, teachers, physical settings, and instructional formats were considered. It was determined that the teachers' amount of technology training had the highest correlation with the students' achievement (Ryan, 1991).

In another study, 950 West Virginia fifth graders from 18 elementary schools were exposed to the Basic Skills/Computer Education Program. Researchers isolated several variables, including time spent on the computer, socioeconomic status, teacher training, and teacher and student attitudes. They found that student achievement was tied directly to the amount of time they were able to use the technology and that dependable access, positive attitudes toward the hardware and software, and importantly, teacher technology training, produced the highest rates of achievement for the students studied (Mann, Shakeshaft, Becker, & Kottkamp, 1999).

Critiques of Technology Use in Schools

It is clear that technology use in our nation's schools is growing, but is it really working? There are many proponents of technology who espouse the virtues of the digital world opening before us, but others have called for more research that ties computer access and use to higher student achievement (Cuban, 2001; Roschelle et al., 2000; Whitehead et al., 2003).

"Performativity," a term coined by Jean-François Lyotard (1984), has been used to describe the way that anything becomes legitimate if it works – a more modern version of Machiavelli's assertion that ends justify means. With this concept of performativity in mind, measurable student performance becomes an end in itself. As such, proponents of technology, armed with data on students' use of software programs, can conceivably make a claim that student success on accountability measurements such as the Texas Assessment of Knowledge and Skills (TAKS) can be attributed to the time students spent using programs such as Scholastic's *ReadAbout* software system. But some are not so sure that technology deserves all of the credit.

In the early days of technology use in K-12 education, Roszak (1994) characterized the computer as being, "a solution in search of problems" to expose the blind faith that proponents had for these tools, believed by many to be the eventual salvation of the public school system in the United States and elsewhere (p. 51). "As things now stand," stated Roszak, "there is an atmosphere of urgent concern…about *somehow* putting this magnificent solution to work in the schools – if only the right problem could be identified" (p. 51). Roszak coined the term, "technopositivism" to explain the sweeping, unquestioning optimism that many in the education community had for the personal computer's potential.

Roszak and others recognized the limitations of the first generation of computers used in schools. Designers of educational software programs were challenged to move technologies beyond the "electronic worksheets" that often characterized early offerings and to incorporate the capability of making them "inquiry and design tools" that would challenge students to employ more active, higher-order thinking skills to complete tasks (Lehrer, 1993; Lehrer, Erickson, & Connell, 1994).

Cuban (2001) stated that most schools still failed to utilize computers in a way that was consistent with research on the use of technology and student achievement. However, a number of studies with contrasting findings have made the question of technology's effectiveness a difficult one to answer. For example, software designed to encourage higher-order thinking skills in math increased achievement, whereas software that merely offered fact practice in an entertaining way appeared to decrease performance (Wenglinsky, 1998). Contrarily, a meta-analysis of over 500 research studies uncovered that positive student outcomes were linked to use of basic tutorial software, and more constructivist uses of technology led to minimal gains (Kulik, 1994). Some critiques call into question the scientific methodology of early meta-analytic efficacy studies (Fletcher-Finn & Gravatt, 1995; Murphy et al., 2002), including the failure of the researchers to inspect connections between the achievement demonstrated and the amount of time the students spent using the software being tested (Viadero, 2007).

Another troubling side effect of personal computer usage as an instructional tool has been the associated movement away from many collaborative learning opportunities. Critics have blamed the misuse of personal computers as a reason for what some studies have found to be questionable effects. For example, it is suspected that the isolating nature of using some computer applications has led to asocial and addictive behavior in students and that computer applications have done little to support the social basis of learning, central to the theory of constructivism (Roschelle et al., 2000).

In support of this assertion, it has been determined that when students collaborated with each other in their learning while receiving CAI, they experienced greater outcomes than when they worked individually, according to a meta-analysis conducted by Lou, Abrami, and d'Apollonia (2001). These findings are in concert with the work of Vygotsky (1978), who wrote at length about the social basis for learning. He stated that when students were provided with opportunities to communicate with one another about their discoveries, they were able to develop a more complex understanding of concepts than when they worked individually. Vygotsky (1978) explained that learning within a group enhanced one's sense of self, and that collaborative work tended to motivate the learner more than independent study.

Some have warned of the "social" relationships into which humans enter with technology itself and the resulting human characteristics that can mistakenly tend to be bestowed upon computers (Agostino, 1999; Reeves & Nash, 1996). Specifically, they cited the expectations we have for computers to function within a set of rules and norms. They found that when technology did not function in a way that subjects expected, frustration and disappointment were often directed at it by users as if the computer were purposefully being obstinate. This form of social interaction is significant because the success or failure of a technological innovation to impact student achievement could very well be determined by what Ferdig (2006) called, "the hidden assumptions and expectations that our students place on the technologies that they interact with rather than the pedagogy or goals we build into those technologies" (p. 756).

Another assertion made by critics has been that positive student outcomes should be expected if costly expenditures on technological panaceas are to be justified (Murphy et al., 2002; Noble, 1996). It has been suggested that the monetary expense of the technological proliferation, along with the potential for technology use to disrupt the social aspects of constructivist learning, should cause educational fiscal managers to be prudent in assessing its effectiveness (Roschelle et al., 2000), or as it has been framed by Strickland et al. (2001) to be practitioners of, “good-teacher consumerism” (p. 392). Roschelle et al. (2000) recommend that from a financial perspective, school systems should have, “clear and broadly generalizable (sic) measures of effectiveness [such as] ‘for every x% of a school budget reallocated to technology, student learning will improve by y%’” (p. 92). A challenge has been issued to companies offering educational software: Produce high-quality, interactive programs that raise student achievement, or lose our business.

This challenge has been accepted by companies such as Scholastic, Inc. and many others, and consequently, a new era for computer-assisted instruction is dawning. The advancements of the last five- to ten years have increased technology capabilities, making educational software systems such as *ReadAbout* more interactive, differentiated, and diagnostic than their predecessors according to promotional material produced by the companies (Scholastic, 2006). However, Cuban (2001) questioned the ability of software to ever supplant or transform direct teacher instruction and he claimed that due to schools’ general resistance to change, for technology to ever influence teaching practice on a large scale, it will happen over the course of many years, if it happens at all.

There is a natural explanation for the persisting optimistic feelings of technopositivism. Promises have been made to educators by the creators of CAI software programs, many of whom have asserted that they are able to do the following: (a) deliver more learning in less time; (b) differentiate learning for every student; (c) help students overcome disadvantages associated with socioeconomic status, race, and gender; (d) make the evaluation of students more objective; (e) simplify record keeping, (f) communicate more effectively with parents, (g) minimize discipline problems; and (h) support staff development and professional conversations (Robertson, 2003; Scholastic, 2006; Viadero, 2007) and to ultimately convert the outdated, teacher-centered classroom of the past into the perceived ideal classroom that is constructivist and student-centered (Robertson, 2003). However, there is a scarcity of independent, scientific research linking student usage of new educational software programs with higher student achievement (Murphy et al., 2002), and so the claims and promises have yet to be substantiated.

Technology Use That Benefits At-Risk Students

In 1990, as technology was just beginning to become widely used in our nation's schools, one in 20 children in the United States was considered an English language learner (ELL), meaning they either spoke no English at all, or their ability to speak English was limited enough to require that they receive supplemental instructional to support the development of English as their second language. Today, the number of students requiring the same support is one in nine; and it is estimated that in 20 years, the number of English Language Learners might be as many as one in four (National Clearinghouse for English Language Acquisition and Language Instruction Educational Programs [NCELA], 2006). By the nature of needing support in their learning because of their language status, these students are classified as being "at-risk," meaning they are at risk of dropping out of high school before graduating.

On average, the academic achievement levels attained by ELL students tend to be lower than that of their non-ELL peers. The 2007 National Assessment of Educational Progress (NAEP) revealed that fourth grade ELL recorded scores 36 points lower than non ELL fourth graders in national reading tests and 25 points lower than non-ELL students in national math tests. The achievement gap was even greater at the eighth grade level – 42 points in reading and 37 points in math – and the gaps at each of these levels is still considerably greater than the 3- to 18-point difference between students who are and are not considered to be economically disadvantaged (U.S. Department of Education, 2008).

As the effort to address minority student achievement and close the achievement gap between students of color and their White peers gained national attention, educators attempted to use technology to assist in this effort. DiCinto and Gee (1999) asserted that students who had not experienced academic success were sometimes not motivated to achieve because the lessons they were presented were not meaningful to their own lives and interests. Dating back to the early 1990s, many believed that classroom use of technology had the potential to engage at-risk students (Cradler et al., 2002; Dunkel, 1990; Means & Knapp, 1991; Roschelle et al., 2000). When teachers presented material to at-risk students in a way that was aligned with their students' own styles of communication and learning, there was great potential for student success (Roschelle et al., 2000).

Mayfield-Stewart et al. (1994) provided an example of effective technology use among at-risk students. Some of the inner-city kindergartners they studied had their language development supplemented by a software program called *Multimedia Environments That Organize and Support Text*, while students in the control group did not. The researchers found that the experimental group demonstrated significant gains in auditory and language skills, were able to articulate details of stories, and had better command of word usage than the control group.

Research also indicated that increasing the accessibility of various forms of technology and computer-assisted lessons increased engagement among English language learners, assisted them in developing writing skills, and encouraged collaboration among students through such means as class websites and blogs (Pennington, 2004).

However, research also suggested that technology was not always used in an equitable manner in low- and high-minority or low- and high-socioeconomic schools (Warschauer et al., 2004). Warschauer et al. (2004) cited inconsistent support networks for students, lingering inaccessibility among students to home computers, and pressure on schools to raise test scores while overcoming the added difficulty of serving high percentages of ELL students.

Research has also suggested that teacher expectations, based upon the socioeconomic status of students, affected the way technology was used by teachers. Low-socioeconomic status students were found to use computers in math and English classes where many technology applications were limited to drill and practice more often than did their high-socioeconomic status peers, whereas for science courses, in which computers were used for higher-order skills such as research and simulations of experiments, this trend was reversed (Becker, 2000). Wenglinsky (1998) and Warschauer (2000) had similar findings and noted that African-American and Hispanic students tended to use computers for basic vocational and remedial work, while White and Asian students were more likely to use technology for academic work.

The inequity divide applies not only to opportunities for technology use, but to the quality of instruction students are likely to receive, as well. Schofield and Davidson (2004) found that Internet access in schools was often used as a reward for the most advanced students. Furthermore, disparities in achievement among "at-risk" students in the general population were correlated to their teachers' own inability or unwillingness to use technology in their instruction (Bransford et al., 1999; Chen & Price, 2006; Otero & Peressini, 2005; Sandholtz, 2001).

Research Specific to the Skill of Learning to Read: An Investigation of "The Fourth Grade Slump"

The National Center for Education Statistics (NCES) reported in a 2000 study (the most recent national figures available) that 37% of U.S. fourth-graders read below the Basic achievement level, 31% were within the Basic level, 24% were within the Proficient level, and 8% were within the Advanced level (U.S. Department of Education, 2000).

Central to the research contained within this Record of Study are the findings of Jeanne Chall, Vicki Jacobs, and Luke Baldwin (1990), who conducted a longitudinal study on how children learned to read. They attempted to explain a phenomenon many intermediate-grades reading teachers had been reporting for years. The teachers found that students who were considered at-risk because of their low socioeconomic status (SES) could typically keep pace with their normative peers in terms of reading achievement until around their fourth-grade year. At that time, many of their reading scores would begin to decline, an effect that the researchers would eventually term, “The Fourth-Grade Slump” (Chall et al., 1990, p. 27).

The researchers selected 30 low SES students from grades 2, 4, and 6 and tested them over such measures as word recognition, word analysis, oral reading, word meaning, reading comprehension, and spelling. Over time, as they had predicted, second- and third-grade low SES students scored at levels comparable to their normative peers, but in fourth grade a significant decline in performance was detected, most notably at first in the category of word meaning, for which they were approximately one year behind grade-level norms. Scores for these students on measures of word recognition and spelling were next to decline, followed by oral reading and comprehension by the time the students reached the sixth- and seventh-grade (Chall et al., 1990).

The origin of the students’ difficultly, it appeared, was with reading vocabulary, which by the fourth grade becomes more abstract and complex as the demands of the material grow proportionately with the material, which often transitions from being fictional narratives in the primary grades to nonfiction, informational texts in the intermediate grades (Chall, 1996; Smith & Wilhelm, 2002). When students were still “learning to read,” they were able to negotiate the requisite skills of decoding, the conversion of individual letters and groups of letters into sounds, which blend to form words (Mesmer & Griffith, 2005), but as they transitioned to "*reading to learn*," a stronger command of vocabulary and more background knowledge was required in order to remain on grade-level (Chall, 1996).

Emergent Literacy: "Learning to Read"

The process of becoming literate is arguably the most important skill a person can learn over the course of a lifetime, and it begins in the first years of life. It has been determined, however, that demographic variables such as poverty (Stipek & Ryan, 1997), low levels of maternal education (Nord et al., 1999), and being a member of a racial or ethnic minority (Swick, Brown, & Boutte, 1994) affect kindergarten readiness.

Hart and Risley (1995) studied infants and toddlers from various SES backgrounds in their home environments in the Kansas City metropolitan area and found that the children of parents on welfare heard an average of 616 spoken words an hour, which is half the number of words heard by children in working-class families of 1,251 per hour and less than one-third of the 2,153 words per hour heard by children in professional families. This difference amounted to a staggering 30-million word deficit for the welfare children by age three.

Before a child ever begins formal schooling, responsibility is in the hands of his or her caregivers to provide as much exposure to rich language and print as possible by reading to the child and also giving the child opportunities to explore books independently, according to researchers (Feitelson & Goldstein, 1986; Hart & Risley, 1995; Neuman, 1999).

According to many, though letter and sound identification, phonological awareness, and word recognition are each important steps in the early process of becoming literate, true reading occurs only when students begin to understand what they have read (Durkin, 1993; Fountas & Pinnell, 2001; Mesmer & Griffith, 2005).

"The important thing about reading is comprehension. Reading is the construction of meaning. Without understanding, there is no reading. Everything about reading is directed toward making meanings that are infused with active curiosity, emotion, and satisfaction," wrote the authors (Fountas & Pinnell, 2001, p. 322).

However, low-achieving students have been found to experience a problem that can grow exponentially frustrating over time; they were not able to easily decode words, so, therefore, it was difficult for them to gain information from and make meaning out of what they attempted to read – to *comprehend* (Pikulski & Chard, 2005).

Intermediate Literacy: "Reading to Learn"

The conundrum for struggling students, reminiscent of those experienced by the Army Air Corps servicemen in Heller's (1961) classic novel *Catch-22*, seemed difficult to overcome. In order to *become* better readers, they needed to *be* better readers. Though many have credited direct phonics instruction as a time-tested means to help emergent readers decode (NICHD, 2000), others have called for equal attention and resources to be spent developing beginning readers' vocabulary and background knowledge as crucial for comprehension (Hirsch, 2006; Walsh, 2003).

Vocabulary Development and Reading Comprehension

The explicit instruction of vocabulary is understood to be an important component to reading instruction in the intermediate grade levels, and researchers have concluded that a large vocabulary leads to greater student outcomes, including improved reading comprehension (Beck, McKeown, & Kucan, 2002; Graves, 2000; NICHD, 2000). Stahl (1999) stated that students must comprehend a minimum of 90% of the words in a passage for them to be able to understand it and thus be able to construct meaning for the other 10% of the words.

Research on fifth-grade ELL students revealed that when they were taught using a regimented program that exposed them to words from high-interest texts, encouraged to discuss the meanings of the words with each other, and then required to synthesize the meanings of the words into their own products, increases were recorded in their ability to learn new words and in their ability to comprehend what they had read (Carlo et al., 2004).

A lack of sufficient academic vocabulary was shown to aggravate the ability to comprehend for many English language learners (Cunningham, 2006; Saville-Troike, 1984). ELL students were typically able to maintain pace with their English-speaking peers in the earliest stages of learning to read, when background knowledge of the language was not required. For each group, the decoding process involved learning that new symbols that were still abstract to ELL and non-ELL students represented sounds, and that sounds were combined to form words (Fitzgerald, 1993; Goldenberg, 2008).

However, as the texts became more difficult, a more developed, academic set of vocabulary and syntax became necessary (August & Shanahan, 2006). Research suggested that rich, meaningful opportunities to engage texts should be provided to ELL students and that teachers should capitalize on students' ability to speak another language by encouraging the use of cognates as learning scaffolds (Fitzgerald, 1993). Without consideration for their special needs, typical, free-standing reading instruction for ELLs became, "insufficient to support equal academic success…simultaneous efforts to increase the scope and sophistication of these students' oral language proficiency [was also required]" (August & Shanahan, 2006, p. 448).

Despite this research that has established the importance of vocabulary development for reading comprehension, it has been found that many teachers do not spend an adequate amount of time presenting effective, explicit vocabulary lessons (Baumann & Kame'enui, 2004; Biemiller, 2004).

Background Knowledge, the Establishment of a Meaningful Context, and Reading Comprehension

Fountas and Pinnell (2001) emphasized "connecting," the term used to describe the way readers accessed previous knowledge to make sense of text, as an important step in the comprehension process that involved the reader's recollection of experiences with similar material and their understanding of the world. They found that the skills necessary to comprehend were developed over time as the text difficulty became greater. As readers came to understand the writer's purpose, and they simultaneously fortified that meaning by summoning their own previous experiences for comparison (Fountas &

Pinnell, 2001). In so doing, the readers were able to analyze, infer, synthesize, and critique. Each of these skills is characteristic of higher-order thinking, outlined by Bloom et al. (1956) in *Taxonomy of Educational Objectives: The Classification of Educational Goals*.

In support of this point, Stanovich (1986) found that students who read below grade-level typically lacked substantial background knowledge to apply to the texts they read. This background knowledge was accessed easily by more capable students, who recalled not only personal experiences, but also prior information from the texts they had successfully read. They were then able to apply that knowledge when it became necessary to do so (Stanovich, 1986).

In early research on the subject of the relationship between background knowledge and comprehension, it was reported that a strong correlation existed between the degree to which background knowledge had been established and results of reading comprehension tests. Pearson, Hansen, and Gordon (1979) asked 20 second-graders of the same relative intelligence and reading ability to read a text about spiders. Ten of the students knew a great deal about the subject, the other 10 did not. The researchers discovered that the 10 students who had prior knowledge on spiders scored significantly higher on the comprehension test questions than the 10 students who knew little or nothing about them. In more recent studies, this finding has been supported using not only comprehension test scores, but report card grades and other methods that determine reading skill (Hofstetter, 1999; Pentony, 1997).

The establishment of a meaningful context also appeared to assist students with reading comprehension. It is believed that creating context activates prior knowledge in students and establishes relevance for the ensuing reading. Wilhelm (2004) determined that it engaged students by tapping into their personal interests, and it encouraged appreciation for the broad, social implications of the subject of the text.

Reading Widely and Often to Support Reading Comprehension

In a comprehensive meta-analysis of research conducted over the last several years, the National Reading Panel acknowledged that many correlational studies have found that reading achievement was increased when students read often, and independently, and that strong readers tended to read more than weak ones (NICHD, 2000).

The seminal research study that established this correlation was conducted on the island of Fiji, where Elley and Mangubhai (1983) worked with 614 underprivileged fourth- and fifth-graders from two separate villages. The experimental group was provided high-interest, illustrated story books and time to read independently, while the control group continued to receive the standard literacy program that was largely teacher-centered and placed little emphasis on sustained, silent student reading. The researchers determined that after eight months, the experimental group grew in their reading comprehension at a rate twice that of the control group. In subsequent studies, the effects were replicated (Anderson, Wilson, & Fielding, 1988; Elley, 1992).

Students who read often were also likely to reap benefits in terms of their vocabulary development (Cunningham & Stanovich, 1998; Fountas & Pinnell, 2001;

Nagy, Herman, & Anderson, 1985). The typical elementary student was shown to learn approximately 3,000 new words per year, the majority of which came from independent reading (Nagy, 1988). In fact, when elementary age students read widely, there was a one-in-twenty chance they would learn a new word through the context of what they read (Fielding, Wilson, & Anderson, 1986). This finding is significant considering that by reading an average of 25 minutes per day, students could successfully navigate through roughly 20,000 words per year, producing an average net gain of 1,000 new vocabulary words (Fountas & Pinnell, 2001).

Research also indicated that students who read often and from a variety of sources did better on their standardized reading tests than their peers who did not. A study of fourth grade students documented that high-performing students read many more words per day, minutes per day, and hours per week than students in the lower achievement groups, who spent sparse amounts of time reading minimal amounts of words (Pinnell et al., 1995).

However, the 2000 report of the National Reading Panel cautioned that the widely-held belief in the existence of a causal relationship between the time students spend reading and their overall achievement should be subjected to further study:

> Even though encouraging students to read more is intuitively appealing, there is still not sufficient research evidence obtained from studies of high methodological quality to support the idea that such efforts reliably increase how much students read or that such programs result in improved reading skills…correlation does not imply causation….No doubt, it could be that the more that children read, the more their reading skills improve, but it is also possible that better readers simply choose to read more….Given the extensive use of these techniques, it is important that such research be conducted. (NICHD, 2000, p. 21)

Conclusion

Through the decades of the 1980s and 1990s, in the dawn of the era of the school reform movement, technology achieved a foothold in the landscape of American schools. As our society moves more fully into the 21st century, we must determine the most appropriate and effective uses of technology. Clearly, emerging technology holds promise for increasing student achievement in reading, but critical evaluation of the software is necessary in order to determine which software systems work best, or whether they work at all (Roschelle et al., 2000; Shamir & Korat, 2006).

Ferdig (2006) addressed the need to develop means by which to assess the effectiveness of technologies. Examining the question, “Is this a good innovation?” he explained that the meaning of the question is changed significantly when it is phased, “Is this innovation *good*?” In the former, an assumption within the framework of innovations is that some are good and some are not, and one is being judged in comparison to others. In the later, external factors are taken into consideration, and researchers are left with the task of determining whether the innovation had a positive overall impact on student learning, or whether it had a negative impact, or no impact at all (Ferdig, 2006).

In order to answer the question, “Is this innovation *good*,” Ferdig (2006) called for studies that determine appropriate uses of technology, assess learning outcome through the use of cognitive tools, and analyze the social and emotional impact of students’ technology usage, possibly through comprehensive qualitative research.

As more and more educational software is evaluated through research, school systems can make determinations that will guide the use of student technology for years to come. However, existing research on the efficacy of educational software is limited and outdated (Murphy et al., 2002; Viadero, 2007). In response to this need for updated research on the subject, the John D. and Catherine T. MacArthur Foundation is supporting a five-year, $50 million initiative that is currently collecting research that will shed light on the subject (MacArthur Foundation, 2006).

Similarly, this research will contribute to the body of knowledge, attempting to determine whether one aspect of educational technology, namely Scholastic's *ReadAbout* software system, improves the reading of intermediate grades students.

CHAPTER III

METHODOLOGY

Preface

The purpose of this chapter is to describe the sampling, testing, and statistical procedures used in this study. The two questions the research addresses are reintroduced for continuity:

1. Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008 school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported in student records at Comal Independent School District, Texas?
2. Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008 school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported for selected student demographic variables in student records at Comal Independent School District, Texas?

To answer these questions, existing data were collected from three sources. Students' scale scores for the 2008 TAKS reading test were recorded from information provided by the Texas Education Agency (TEA). The amount of time the students spent utilizing the *ReadAbout* software program was gathered from the Comal ISD *ReadAbout* database. Demographic information including the students' gender, ethnicity, and socioeconomic status was collected through the Public Education Information

Management Systems (PEIMS) for the purpose of answering the second research question.

Population

For the purpose of this study, student data were collected from nine elementary schools: Bill Brown Elementary, Comal Elementary, Freiheit Elementary, Goodwin Frazier Elementary, Hoffmann Lane Elementary, Rahe Bulverde Elementary, Rebecca Creek Elementary, Specht Elementary, and Startzville Elementary, each in the Comal Independent School District. Students identified for the study were either third- or fourth-grade students at one of the aforementioned schools, and they took the third- or fourth-grade Texas Assessment of Knowledge and Skills (TAKS) reading test during the spring semester of the 2008 school year.

All students included in the study were issued a *ReadAbout* account within the first month of the school year 2007-2008. The data collected indicated that the range for amount of time the students spent using the software varied widely, from as little as no minutes, to as many as 3,519 minutes. For the purpose of this study, in order to determine the effect of the treatment on student performance, the terminal date for student usage of the *ReadAbout* software program was common for all students. No time students spent on the program after their testing date is considered a part of the record. All third graders were administered the TAKS reading on March 5, 2008, and all fourth graders were administered the TAKS reading on April 30, 2008. The population for the analysis is summarized below in Table 3.1.

Table 3.1. Summary of the Population of Students Under Study From Elementary Schools in the Comal Independent School District, Texas

School	Grade 3	Grade 4
Bill Brown Elementary	83	62
Comal Elementary	72	95
Freiheit Elementary	63	127
Goodwin Frazier Elementary	63	93
Hoffmann Lane Elementary	36	119
Rahe Bulverde Elementary	74	58
Rebecca Creek Elementary	20	37
Specht Elementary	84	111
Startzville Elementary	90	90
Totals	585	792

Instrumentation

The amount of time that students spent using the *ReadAbout* software system served as the independent variable for this study. The *ReadAbout* system is described in the Teacher Implementation Guide (Scholastic, 2006) as “a breakthrough content-area reading program that provides differentiated instruction, reading comprehension, and vocabulary to all students through adaptive technology" (p. 4).

Scholastic, Inc. makes a claim that the *ReadAbout* software program is research-based, and it focuses learning during each session on the three particular areas that are *most* important for intermediate grades (third through fifth) readers – reading comprehension skills and strategies, vocabulary, and content-area knowledge (Scholastic, 2006).

Scholastic, Inc. explains that their research on "best practices" guided the development of *ReadAbout*, and thus, elements of these practices relating to the three prominent areas of concentration can be found in its features. Among these practices are "anchored instruction," "differentiated instruction," "motivation," and "continuous assessment" (Scholastic, 2006, pp. 14-15). Anchored instruction builds prerequisite background knowledge on topics, which promotes comprehension (Wilhelm, 2004). Differentiated instruction customizes lessons for the individual needs of learners, and this is easily done through the use of technology (Meyer & Rose, 2000). Engaging forms of assessment such as games make learning fun for students and motivate them to want to continue to learn (Jenkins, 2005). When instruction and assessment are aligned and when students receive timely feedback on their learning, they make greater gains (Pellegrino, Chudowsky, & Glaser, 2001). Specific features of the *ReadAbout* software system related to "best practices" are outlined below in Table 3.2.

Table 3.2. Features of the *ReadAbout* Software System Related to Targeted Skills and "Best Practices"

Targeted Skill	"Best Practice"	Feature
Comprehension Skills and Strategies	Anchored Instruction	• Skill Briefs activate existing knowledge, provide instruction, and introduce skill-specific language
Comprehension Skills and Strategies	Differentiated Instruction	• Direct instruction and Skill Tutorials in the software are based on a student's performance • Report data may be used to select skill lessons
Comprehension Skills and Strategies	Motivation	• Earning stars on Skill Cards allows students to unlock special challenges
Comprehension Skills and Strategies	Continuous Assessment	• Students receive targeted corrective feedback on comprehension questions
Vocabulary	Anchored Instruction	• Smart Words pre-teach academic and content-area words that appear in the software passages
Vocabulary	Differentiated Instruction	• Software supports are available for academic words, cognates, and idioms
Vocabulary	Motivation	• Smart Word activities, such as card collecting and word challenges, encourage vocabulary learning
Vocabulary	Continuous Assessment	• Students receive immediate feedback during the vocabulary activities
Content-Area Knowledge	Anchored Instruction	• Anchor videos help students form mental models
Content-Area Knowledge	Differentiated Instruction	• Nonfiction topic choices are based on a student's reading level, skills needed, and grade level
Content-Area Knowledge	Motivation	• Interrelated passages motivate students to learn and apply content-area knowledge
Content-Area Knowledge	Continuous Assessment	• The software chooses the text level of passages based on student performance

Source. *Scholastic*, 2006, pp. 14-15.

Procedures

The dependant variable for the study was student achievement, as reflected in the third- and fourth-grade students' scores on the 2008 TAKS reading test. This data were collected from student records on file with the Comal ISD.

The Comal ISD Central Office approved the data collecting procedures for this study and provided written permission to access the data in June 2008. Information on a total of 585 third graders and 792 fourth graders comprised the data set. The Comal ISD *ReadAbout* database was accessed in order to determine the amount of time each of the students spent using the program from the day the 2007-2008 school year started (August 28, 2007) until the day before the TAKS reading tests were administered (March 4, 2008 for third graders and April 29, 2008 for fourth graders). TEA student performance reports and PEIMS data were accessed in order to complete the data strings, which were entered into Microsoft Excel spreadsheet files for each campus and grade level and included such information as students' grade level, campus, gender, ethnicity, language of learning, socioeconomic status, and scale score on the 2008 TAKS reading test. These were eventually consolidated into a single Microsoft Excel spreadsheet. This spreadsheet was then loaded into the Statistical Package for Social Studies (SPSS) software system for analysis.

Data Analysis

The data were analyzed using quantitative statistical techniques as outlined *Educational Research: An Introduction* by Gall et al. (1996). Using version 11/5/1 of the

Statistical Package for Social Studies (SPSS) software, one- and two-way Analysis of Variance (ANOVA) tests were run.

To answer the first research question, simple correlations, or one-way Analysis of Variance (ANOVA) tests were run for each of the grade levels, combining the scale score results of the students' TAKS reading test and their time spent using the *ReadAbout* software system. Then, Scheffe Post Hoc tests were administered to determine the usage categories for each grade level that were considered statistically different.

In order to answer the second research question, students were grouped into five categories based upon the amount of time they spent using the program: "minimal users," "low users," "moderate users," "considerable users," and "high users." Table 3.3 depicts the number of minutes that were used to define each category. Through an ANOVA for each grade level, the mean of the TAKS reading test scale scores of students in each category were compared. Then, students in each of the five groups were further categorized into additional groups. Students of low socioeconomic and non-low socioeconomic status, as reflected in PEIMS data, comprised two of the additional groups. Students whose first language was English as compared to students whose first language was Spanish, as reflected in PEIMS data derived from language assessments administered to students upon their enrollment into the public school system, comprised two more groups. The gender of the students was also taken into consideration to determine if the *ReadAbout* program had a greater impact on boys or girls.

An ANOVA was run to examine the relationship between student usage of the *ReadAbout* program and the students' scale scores on the 2008 TAKS reading test, accounting for the socio-economic status, language of learning, and gender of each student.

Table 3.3. Categories of Student Usage of the *ReadAbout* Program and the Number of Minutes Used to Define Each Category

Category	Minutes
Minimal	0-138
Low	139-369
Moderate	371-644
Considerable	645-998
High	1000-3519

Additionally, three categories used by the Texas Education Agency (TEA) to qualify student performance on the tests were used as a starting point for another set of ANOVA. These categories were, "Did Not Meet Standard" (the student scored below state expectations on the TAKS reading test), "Met Standard" (the student scored within an acceptable range on the TAKS reading test as defined by the state), and "Commended Performance" (the student demonstrated a high degree of mastery on the TAKS reading test by answering only one or two questions incorrectly, or by receiving a perfect score).

The categories into which students' scale scores fell were compared against the number of minutes the students in each category spent using the *ReadAbout* program.

These categories, as well as the scores used to define them, are shown in Table 3.4. In addition to the performance categories and scale scores, two-way ANOVA and Scheffe Post Hoc tests were run to determine if there were distinctions within usage group categories between boys and girls, students of high- and low-socioeconomic status, and students whose first language of learning was English versus students whose first language of learning was Spanish.

Table 3.4. Categories Used by the Texas Education Agency (TEA) to Define Student Performance on the Texas Assessment of Academic Skills (TAKS) Reading Test

Category	Scale Score
“Did Not Meet Standard”	0-2099
“Met Standard”	2100-2399
“Commended Performance”	2400-2616

Chapter IV will present the findings from these analyses.

CHAPTER IV

PRESENTATION OF THE FINDINGS

The effectiveness of the program will guide the Comal Independent School District in determining whether spending money designated for instructional purposes on this product, a supplement to teacher-directed intermediate-grades reading instruction, is justified. In this chapter, the findings of the research are presented.

Findings for Research Question 1

Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008 school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported in student records at Comal Independent School District, Texas?

As it was established in Chapter III, a total of 585 third graders and 792 fourth graders were assigned a *ReadAbout* account during the 2007-2008 school year and, thus, comprised the data set. The Comal ISD *ReadAbout* database was accessed in order to determine the amount of time each of the students spent using the program from August 28, 2007, which was the day the 2007-2008 school year started, until the day before the TAKS reading tests were administered. Five categories were created in order to distinguish among the amounts of time that the students utilized the software. Students who spent fewer than 138 minutes on the software were considered “minimal” users. Students whose time spent on the program ranged between 139 and 369 minutes were designated as “low” users. Students who recorded between 371 and 644 minutes were considered “moderate” users. “Considerable” users were those students who spent between 645 and 998 minutes using the program, and "high" users' time ranged between 1000 and 3519 minutes. Tables 4.1 and 4.2 indicate the number of third and fourth grade students whose usage fell into each category.

Table 4.1. Distribution in Groups by Level of *ReadAbout* Software Program Usage of Third Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

ReadAbout Usage Level	Third Grade Students N
Minimal	116
Low	87
Moderate	181
Considerable	158
High	43
Total	585

Table 4.2. Distribution in Groups by Level of *ReadAbout* Software Program Usage of Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

ReadAbout Usage Level	Fourth Grade Students N
Minimal	159
Low	189
Moderate	95
Considerable	116
High	223
Total	792

The Texas Education Agency's Texas Assessment of Knowledge and Skills (TAKS) reading test was used as a common, standardized measurement of student achievement. Performance reports for the students who used the *ReadAbout* software program were accessed and entered into Microsoft Excel spreadsheet files for the purpose of determining the effect of the amount of time each student spent using the software on their reading achievement. Next, these two pieces of data were insolated for third graders and fourth graders to analyze and compare the differences of means in their scale scores on the TAKS reading test through a one-way ANOVA test using the Statistical Package for the Social Science (SPSS) software, version 11/5/1.

Third Grade

Table 4.3 shows the third grade usage group results from the one-way Analysis of Variance (ANOVA) performed after including the scale scores from the third grade TAKS reading test, and Table 4.4 shows a summary of the inferential statistics for the same group.

Table 4.3. Descriptive Statistics of 2008 Third Grade TAKS Reading Test Scale Scores for Groups of Third Graders Formed by *ReadAbout* Software Program Usage Level in the Comal Independent School District, Texas

Level of *ReadAbout* usage	Students N	TAKS scale score mean	Standard deviation	Standard error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Minimal	116	2269.09	206.371	19.161	2231.14	2307.05	1791	2615
Low	87	2227.95	147.410	15.804	2196.54	2259.37	1856	2615
Moderate	181	2274.70	158.776	11.802	2251.41	2297.99	1875	2615
Considerable	158	2323.09	159.375	12.679	2298.05	2348.14	1835	2615
High	43	2244.07	153.608	23.425	2196.80	2291.34	1893	2615
Total	585	2277.46	170.026	7.030	2263.65	2291.26	1791	2615

Table 4.4. Summary of Inferential Statistics Test Analysis of Variance (ANOVA) Scale Scores From the Spring 2008 Administration of Third Grade TAKS Reading Test for Groups of Third Graders Formed by *ReadAbout* Software Program Usage Level in the Comal Independent School District, Texas

	Sum of squares	Degree of freedom	Mean square	F	Significance*
Between groups	599701.1	4	149925.277	5.340	< 0.001
Within groups	16283112	580	28074.331		
Total	16882813	584			

*Significant at the 0.05 level.

Analysis Results of the Impact of Third Grade Student Usage of the ReadAbout Software Program on Third Grade TAKS Reading Test Scores

The null hypothesis investigating the relationship between third grade student usage of the *ReadAbout* Software Program and third grade TAKS reading test scale scores was analyzed using a one-way ANOVA. Table 4.3 reports the descriptive statistics for the usage groups. Table 4.4 reports the summary of inferential statistics for the third grade usage groups. The level of significance for the procedure was less than 0.001. This was less than the alpha level of 0.05. As a result, the decision was made to reject the null hypotheses of no difference. Therefore, it was inferred that the means in the third grade population, from which the samples were drawn, were different. There is a statistical difference between the population means. Indications are that the amount of time that third grade students spent utilizing the *ReadAbout* software program made a difference on their reading achievement as reported in their scale scores on the 2008 Third Grade TAKS reading test.

In order to determine the third grade usage level groups that were statistically the same and the ones that were statistically different, a set of Scheffe Post Hoc tests were run. Through this analysis, it was determined that the groups for which usage level was characterized as “minimal,” “low,” “moderate,” and “high” were statistically the same, as were the groups for which usage was characterized as “minimal,” “moderate,” and “considerable.” The “low” and “high” usage groups are considered statistically different from the “considerable” usage level group. Table 4.5 shows the results of these comparisons.

Table 4.5. Comparisons of the Mean Scale Scores on the 2008 Third Grade TAKS Reading Test for Groups of Third Graders Formed by *ReadAbout* Software Program Usage Level in the Comal Independent School District, Texas

Time using *ReadAbout* software - Five groups	N	Subset for alpha= .05 1	 2
Low	87	2227.95	
High	43	2244.07	
Minimal	116	2269.09	2269.09
Moderate	181	2274.70	2274.70
Considerable	158		2323.09
Significance		.475	.320

Fourth Grade

Table 4.6 shows the fourth grade usage group results from the one-way ANOVA performed after including the scale scores from the fourth grade TAKS reading test, and Table 4.7 shows a summary of the inferential statistics for the same group.

Table 4.6. Descriptive Statistics of 2008 Fourth Grade TAKS Reading Test Scale Scores for Groups of Fourth Graders Formed by *ReadAbout* Software Program Usage Level in the Comal Independent School District, Texas

Level of *ReadAbout* usage	Students N	TAKS scale score mean	Standard deviation	Standard error	95% confidence interval for mean Lower bound	Upper bound	Minimum	Maximum
Minimal	159	2231.53	200.155	15.873	2200.18	2262.88	1313	2616
Low	189	2296.46	175.920	12.798	2271.21	2321.70	1313	2616
Moderate	95	2263.16	164.103	16.837	2229.73	2296.59	1920	2616
Considerable	116	2222.71	162.662	15.103	2192.79	2252.62	1758	2616
High	233	2224.89	194.416	12.737	2199.80	2249.99	1313	2616
Total	792	2247.57	185.431	6.589	2234.64	2260.51	1313	2616

Table 4.7. Summary of Inferential Statistics Test Analysis of Variance (ANOVA) Scale Scores From the Spring 2008 Administration of Fourth Grade TAKS Reading Test for Groups of Fourth Graders Formed by *ReadAbout* Software Program Usage Level in the Comal Independent School District, Texas

	Sum of squares	Degree of freedom	Mean square	F	Significance*
Between groups	707192.4	4	176798.106	5.252	< 0.001
Within groups	26491209	787	33661.003		
Total	27198402	791			

*Significant at the 0.05 level.

Analysis Results of the Impact of Fourth Grade Student Usage of the ReadAbout Software Program on Fourth Grade TAKS Reading Test Scores

The null hypothesis investigating the relationship between fourth grade student usage of the *ReadAbout* Software Program and fourth grade TAKS reading test scale scores was analyzed using a one-way ANOVA. Table 4.6 reports the descriptive statistics for the usage groups. Table 4.7 reports the summary of inferential statistics for the fourth grade usage groups. The level of significance for the procedure was less than 0.001. This was less than the alpha level of 0.05. As a result, the decision was made to reject the null hypotheses of no difference. Therefore, it was inferred that the means in the fourth grade population, from which the samples were drawn, were different. There is a statistical difference between the population means. Indications are that the amount of time that fourth grade students spent utilizing the *ReadAbout* software program made a difference on their reading achievement as reported in their scale scores on the 2008 Fourth Grade TAKS reading test.

In order to determine the fourth grade usage level groups that were statistically the same and the ones that were statistically different, a set of Scheffe Post Hoc tests were run. Through this analysis, it was determined that the groups for which usage level was characterized as “minimal,” “moderate,” “considerable,” and “high” were statistically the same, as were the groups for which usage was characterized as “minimal,” “low,” and “moderate.” The “considerable” and “high” usage groups are considered statistically different from the “low” usage level group. Table 4.8 shows the results of these comparisons.

Table 4.8. Comparisons of the Mean Scale Scores on the 2008 Fourth Grade TAKS Reading Test for Groups of Fourth Graders Formed by *ReadAbout* Software Program Usage Level in the Comal Independent School District, Texas

Time using *ReadAbout* software - Five groups	Students N	Subset for alpha= .05 1	2
Considerable	116	2222.71	
High	233	2224.89	
Minimal	159	2231.53	2231.53
Moderate	95	2263.16	2263.16
Low	189		2296.46
Significance		.483	.064

Findings for Research Question 2

Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008 school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported for selected student demographic variables in student records at Comal Independent School District, Texas?

A total of 1,377 third and fourth grade Comal ISD students utilized the *ReadAbout* software program during the 2007-2008 school year. The Comal ISD *ReadAbout* database was accessed in order to determine the amount of time each of the students spent using the program from August 28, 2007, the first day of the school year, until the day before the TAKS reading tests were administered. For the second research question, five categories were created in order to distinguish between the amounts of time that the students utilized the software. For the sake of analysis, each of the categories had virtually the same number of members, ranging between 274 and 276 students. Students whose time using the *ReadAbout* program was in the lowest 19th percentile of overall users were categorized as “minimal” users. Students whose time spent on the program ranged in the 20th percentile to 39th percentile were designated as “low” users. Students whose time spent using the program ranged within the next quintile of 40th percentile to 59th percentile were considered “moderate” users. “Considerable” users were those students whose time spent using the program fell within the top 60th percentile to the top 79th percentile, and “high” users’ time ranged within the highest quintile of the top 80th percentile to the top 99th percentile. Table 4.9

indicates the combined number of third and fourth grade students in each of these categories.

Table 4.9. Distribution in Percentile Groups by Level of *ReadAbout* Software Program Usage of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

Usage	Value Label	N
Time using the *ReadAbout* software program	Minimal (1^{st}-19^{th} percentile)	275
	Low (20^{th}-39^{th} percentile)	276
	Moderate (40^{th}-59^{th} percentile)	276
	Considerable (60^{th}-79^{th} percentile)	274
	High (80^{th}-99^{th} percentile)	276
	Total	1377

An overall mean TAKS reading test scale score was determined for each of the five time categories. In order to determine if the *ReadAbout* software program had a greater impact on students who belonged to particular demographic subgroups, time and performance data were disaggregated further for gender, primary language of learning status, and socio-economic status.

Gender

Table 4.10 shows the between-subjects factors of usage group results and gender from the Analysis of Variance, and Table 4.11 shows the descriptive statistics of the 1,377 students who took the TAKS reading test into either female or male categories. According to this table, the number of females for the “minimal usage” category was

132 and the number of males for the “minimal usage” category was 143. The number of females for the “low usage” category was 137 and the number of males for the “low usage” category was 139. The number of females for the “moderate usage” category was 133 and the number of males for the “moderate usage” category was 143. The number of females for the “considerable usage” category was 128 and the number of males for the “considerable usage” category was 146. Finally, the number of females for the “high usage” category was 132 and the number of males for the “high usage” category was 144.

Table 4.10. Distribution in Percentile Groups by Level of *ReadAbout* Software Program Usage and Gender of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

Usage and Gender	Value Label	N
Time using the *ReadAbout* software program	Minimal (1^{st}-19^{th} percentile)	275
	Low (20^{th}-39^{th} percentile)	276
	Moderate (40^{th}-59^{th} percentile)	276
	Considerable (60^{th}-79^{th} percentile)	274
	High (80^{th}-99^{th} percentile)	276
	Total	1377
Gender	Female	662
	Male	715
	Total	1377

Table 4.11. Descriptive Statistics of Scale Scores Reported by Level of Usage and Gender of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

Time Using *ReadAbout*	Gender	Mean	Standard Deviation	N
Minimal	Female	2264.52	170.744	132
	Male	2231.55	228.719	143
	Total	2247.37	203.277	275
Low	Female	2271.29	151.527	137
	Male	2278.38	187.285	139
	Total	2274.86	170.203	276
Moderate	Female	2283.43	171.077	133
	Male	2258.92	149.478	143
	Total	2270.73	160.425	276
Considerable	Female	2287.65	176.173	128
	Male	2274.41	160.841	146
	Total	2280.59	167.996	274
High	Female	2225.58	181.445	132
	Male	2229.99	195.388	144
	Total	2227.88	188.519	276
Total	Female	2266.43	171.227	662
	Male	2254.56	186.947	715
	Total	2260.27	179.594	1377

Results for Combined Third and Fourth Grade TAKS Reading Test Scores, ReadAbout Software Program Usage and Gender

Part “A” of the second research question was investigated using an ANOVA test. The researcher was interested in determining if a relationship existed between student usage of *ReadAbout* and achievement as determined by scale scores on the TAKS reading test according to a student’s gender. Table 4.12 shows through inferential statistics that due to a .002 significance score, there is a statistically significant difference between the TAKS reading test scale scores of students belonging to different *ReadAbout* usage groups, and Table 4.13 compares the mean scale scores on the TAKS reading test by usage groups. However, the significance level of .22 for gender suggests that there is not a statistically significant difference between the mean scale scores of male and female students. When the two conditions of student usage of the *ReadAbout* program and gender were examined together, the significance level was .618. The null hypothesis for part "A" of this second research question is that there is no relationship between mean student scale scores on TAKS reading test, student usage of the *ReadAbout* software program, and students' gender. Because .618 is greater than the critical value of .005, the decision was made to fail to reject the null hypothesis of no difference. Therefore, it was inferred that the means in the population, from which the samples were drawn, were the same. There is not a significant statistical difference between the population means. Male students whose usage of the *ReadAbout* software program was similar to the *ReadAbout* usage of female students had no greater success rate on the 2008 TAKS reading test than their female classmates.

Table 4.12. Summary of Analysis of Variance (ANOVA) Test by Student Usage of the *ReadAbout* Software Program and Gender of Third and Fourth Grade Students who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in the Spring 2008 in the Comal Independent School District, Texas

Source	Degree of freedom	F	Significance*
Minutes (Five groups)	4	4.227	.002
Gender	1	1.508	.220
Minutes by gender	4	.663	.618

*Significant at the 0.05 level.

Table 4.13. Comparisons of the Mean Scale Scores on the 2008 TAKS Reading Test for Groups of Third and Fourth Graders Formed by *ReadAbout* Software Program Usage Level in the Comal Independent School District, Texas

Time using *ReadAbout* software-Five groups	N	Subset for alpha= .05 1	 2
High	276	2227.95	
Minimal	275	2247.37	2247.37
Moderate	276	2270.73	2270.73
Low	276	2274.86	2274.86
Considerable	274		2280.59
Significance		.050	.314

Primary Language of Learning

Table 4.14 shows the between-subjects factors of usage group results and gender from the ANOVA, and Table 4.15 shows the descriptive statistics of the 1,377 students who took the TAKS reading test into groups whose primary language of learning is either Spanish, which is considered by the state of Texas to be “Limited English Proficient” (LEP), or English (non-LEP). According to this table, the number of LEP students for the “minimal usage” category was 8 and the number of non-LEP students for the “minimal usage” category was 267. The number of LEP students for the “low usage” category was 9 and the number of non-LEP students for the “low usage” category was 267. The number of LEP students for the “moderate usage” category was 32 and the number of non-LEP students for the “moderate usage” category was 244. The number of LEP students for the “considerable usage” category was 22 and the number of non-LEP students for the “considerable usage” category was 252. Finally, the number of LEP students for the “high usage” category was 13 and the number of non-LEP students for the “high usage” category was 263. It should be noted that the relatively small number of LEP students in the “minimal usage,” “low usage,” and “high usage” categories (8 students, 9 students, and 13 students, respectively) do not constitute a sample size that is generally considered large enough in order to draw definitive conclusions. Therefore, extreme caution should be used when making inferences based upon these data sets.

Table 4.14. Distribution in Percentile Groups by Level of *ReadAbout* Software Program Usage and Primary Language of Learning of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

Usage and Primary Language	Value Label	N
Time using the *ReadAbout* software program	Minimal (1^{st}-19^{th} percentile)	275
	Low (20^{th}-39^{th} percentile)	276
	Moderate (40^{th}-59^{th} percentile)	276
	Considerable (60^{th}-79^{th} percentile)	274
	High (80^{th}-99^{th} percentile)	276
	Total	1377
Bilingual program status	Not Served	1293
	Served	84
	Total	1377

Table 4.15. Descriptive Statistics of Scale Scores Reported by Level of Usage and Gender, of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

Time using *ReadAbout*	Primary Language	Mean	Standard Deviation	N
Minimal	English	2254.48	200.540	267
	Spanish	2010.25	151.811	8
	Total	2247.37	203.277	275
Low	English	2275.64	171.788	267
	Spanish	2251.67	118.108	9
	Total	2274.86	170.203	276
Moderate	English	2273.36	162.522	244
	Spanish	2250.66	144.182	32
	Total	2270.73	160.425	276
Considerable	English	2289.42	165.802	252
	Spanish	2179.50	163.330	22
	Total	2280.59	167.996	274
High	English	2226.46	190.320	263
	Spanish	2256.69	150.541	13
	Total	2227.88	188.519	276
Total	English	2263.52	180.237	1293
	Spanish	2210.56	162.290	84
	Total	2260.27	179.594	1377

Results for Combined Third and Fourth Grade TAKS Reading Test Scores, ReadAbout Software Program Usage and Primary Language of Learning

Part “B” of the second research question was investigated using an ANOVA test. The researcher was interested in determining if a relationship existed between student usage of *ReadAbout* and achievement as determined by scale scores on the TAKS reading test based upon students’ primary language of learning. Table 4.16 shows through inferential statistics that due to a .008 significance score, there is a statistically significant difference between the TAKS reading test scale scores of students belonging to different *ReadAbout* usage groups, and Table 4.17 compares the mean scale scores on the TAKS reading test by usage groups. The significance level of .001 for primary language of learning status suggests that there is also a significant statistical difference between the mean scale scores of LEP and non-LEP students. When the two conditions of student usage of the *ReadAbout* program and primary language of learning status were examined together, the significance level was .005.

Table 4.16. Summary of Analysis of Variance (ANOVA) Test by Student Usage of the *ReadAbout* Software Program and Primary Language of Learning of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in the Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

	Degree of freedom	F	Significance*
Minutes (Five groups)	4	3.459	.008
Primary language	1	10.647	.001
Minutes and primary language	4	3.691	.005

*Significant at the 0.05 level.

Table 4.17. Comparisons of the Mean Scale Scores on the 2008 TAKS Reading Test for Groups of Third and Fourth Graders Formed by *ReadAbout* Software Program Usage Level in the Elementary Schools of the Comal Independent School District, Texas

Time using *ReadAbout* software - Five groups	N	Subset for alpha= .05	
		1	2
High	276	2227.95	
Minimal	275	2247.37	2247.37
Moderate	276	2270.73	2270.73
Low	276		2274.86
Considerable	274		2280.59
Significance		.092	.307

The null hypothesis for part “B” of this second research question is that there is no relationship between mean student scale scores on TAKS reading test, student usage of the *ReadAbout* software program, and students’ primary language of learning. Because .005 is less than the critical value, the alpha level of 0.05, the decision was made to reject the null hypothesis of no difference. Therefore, it was inferred that the means in the populations from which the samples were drawn were different. There is a significant statistical difference between the population means. In the “low,” “minimal,” “moderate,” and “considerable” usage group categories, non-LEP students who spent similar amounts of time on the *ReadAbout* software program as their LEP peers outperformed them on the 2008 TAKS reading test.

However, due to the low number of LEP students in the “minimal” and “low” usage groups, extreme caution should be used before these conclusions may be generalized. As depicted in Figure 4.1, in the “high” usage group, LEP students actually outperformed their non-LEP peers, recording a mean scale score that was 30 points higher; but again, the population set for “high usage” LEP students only contained 13 members, and conclusions drawn from these data should be made carefully.

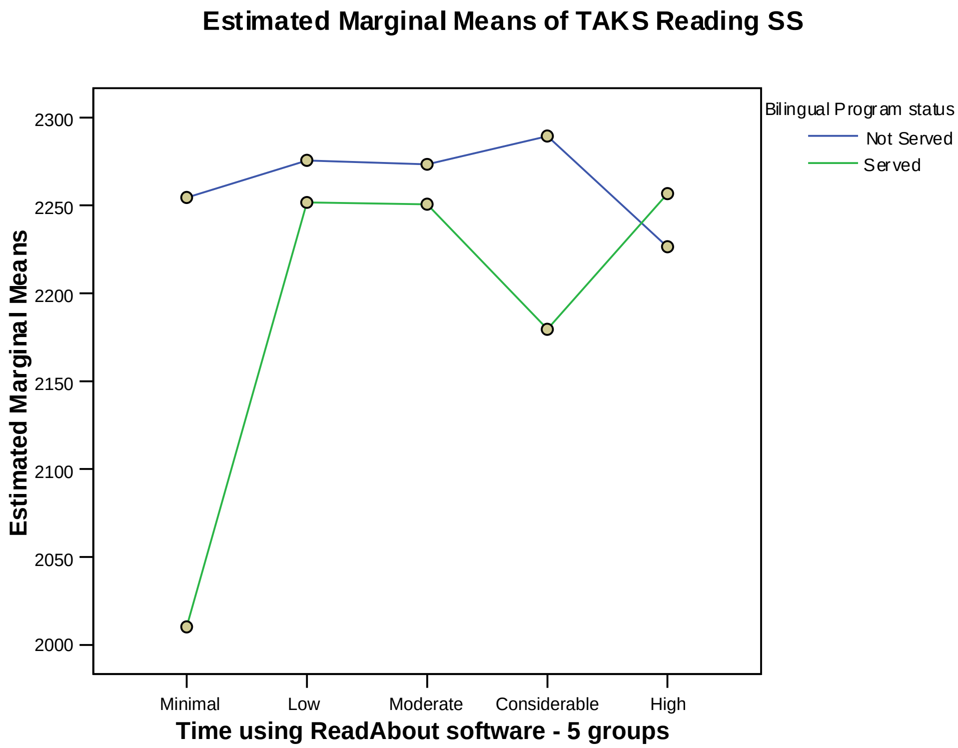

Figure 4.1. Results of Analysis of Variance (ANOVA) Test for Interaction Between Student *ReadAbout* Software Program Usage, Student Texas Assessment of Knowledge and Skills (TAKS) Reading Test Scale Score Means, and Student Primary Language of Learning, for Third and Fourth Grade Students Who Took the TAKS Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas.

Socio-Economic Status

Table 4.18 shows the between-subjects factors of usage group results and socio-economic status from the ANOVA, and Table 4.19 shows the descriptive statistics of the 1,377 students who took the TAKS reading test into either economically disadvantaged or non-economically disadvantaged categories. According to this table, the number of economically disadvantaged students for the "minimal usage" category was 120 and the number of non-economically disadvantaged students for the “minimal usage” category was 155. The number of economically disadvantaged students for the “low usage” category was 98 and the number of non-economically disadvantaged students for the “low usage” category was 178. The number of economically disadvantaged students for the “moderate usage” category was 130 and the number of non-economically disadvantaged students for the “moderate usage” category was 146. The number of economically disadvantaged students for the “considerable usage” category was 117 and the number of non-economically disadvantaged students for the “considerable usage” category was 157. Finally, the number of economically disadvantaged students for the “high usage” category was 121 and the number of non-economically disadvantaged students for the “high usage” category was 155.

Table 4.18. Distribution in Percentile Groups by Level of *ReadAbout* Software Program Usage and Socio-Economic Status of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

Usage and Socio-economic status	Value Label	N
Time using the ReadAbout software program	Minimal (1^{st}-19^{th} percentile)	275
	Low (20^{th}-39^{th} percentile)	276
	Moderate (40^{th}-59^{th} percentile)	276
	Considerable (60^{th}-79^{th} percentile)	274
	High (80^{th}-99^{th} percentile)	276
	Total	1377
Socio-economic status	Economically disadvantaged	586
	Not economically disadvantaged	791
	Total	1377

Table 4.19. Descriptive Statistics of Scale Scores Reported by Level of *ReadAbout* Software Program Usage and Gender of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

Time using ReadAbout	Gender	Mean	Standard Deviation	N
Minimal	Eco.Dis.	2181.69	213.811	120
	Non-Eco.Dis.	2298.23	179.529	155
	Total	2247.37	203.277	275
Low	Eco.Dis	2201.54	165.041	98
	Non-Eco.Dis	2315.23	159.580	178
	Total	2274.86	170.203	276
Moderate	Eco.Dis	2223.84	156.262	130
	Non-Eco.Dis	2312.48	152.841	146
	Total	2270.73	160.425	276
Considerable	Eco.Dis.	2230.79	171.299	117
	Non-Eco.Dis	2317.71	155.961	157
	Total	2280.59	167.996	274
High	Eco.Dis	2191.30	172.193	121
	Non-Eco.Dis.	2256.44	196.181	155
	Total	2227.88	188.519	276
Total	Eco.Dis.	2206.15	177.381	586
	Non-Eco-Dis.	2300.36	170.582	791
	Total	2260.27	179.594	1377

Results for Combined Third and Fourth Grade TAKS Reading Test Scores, ReadAbout Software Program Usage and Socio-Economic Status

Part “C” of the second research question was investigated using an ANOVA test. The researcher was interested in determining if a relationship existed between student usage of *ReadAbout* and achievement as determined by scale scores on the TAKS reading test according to a student’s socio-economic status. Table 4.20 shows through inferential statistics that due to a .004 significance score, there is a statistically significant difference between the TAKS reading test scale scores of students belonging to different *ReadAbout* usage groups, and Table 4.21 compares the mean scale scores on the TAKS reading test by usage groups. The significance level of .000 for socio-economic status suggests that there is also a significant statistical difference between the mean scale scores of economically disadvantaged and non-economically disadvantaged students. However, when the two conditions of student usage of the *ReadAbout* program and socio-economic status were examined together, the significance level was .400.

Table 4.20. Summary of Analysis of Variance (ANOVA) Test by Student Usage of the *ReadAbout* Software Program and Socio-Economic Status of Third and Fourth Grade Students Who Took the Texas Assessment of Knowledge and Skills (TAKS) Reading Test in the Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas

Source	Degrees of freedom	F	Significance*
Minutes (Five groups)	4	3.925	.004
Socio-economic status	1	99.423	.000
Minutes by socio-economic status	4	1.012	.400

*Significant at the 0.05 level.

Table 4.21. Comparisons of the Mean Scale Scores on the 2008 TAKS Reading Test for Groups of Third and Fourth Graders Formed by *ReadAbout* Software Program Usage Level in the Elementary Schools of the Comal Independent School District, Texas

Time using *ReadAbout* software - Five groups	N	Subset for alpha= .05	
		1	2
High	276	2227.88	
Minimal	275	2247.37	2247.37
Moderate	276	2270.73	2270.73
Low	276		2274.86
Considerable	274		2280.59
Significance		.076	.278

The null hypothesis for part “C” of this second research question is that there is no relationship between mean student scale scores on the TAKS reading test, student usage of the *ReadAbout* software program, and students’ socio-economic status. Because .400 is greater than the critical value of .005, the decision was made to fail to reject the null hypothesis of no difference.

Therefore, it was inferred that the means in the population, from which the samples were drawn, were the same. As depicted in Figure 4.2, there is not a significant statistical difference between the population means. In other words, economically disadvantaged students whose usage of the *ReadAbout* software program was similar to the *ReadAbout* usage of non-economically disadvantaged students had no greater success rate on the 2008 TAKS reading test than their non-economically disadvantaged classmates.

Summary of Findings

The purpose of this research was to determine the impact of the *ReadAbout* software system, a supplement to teacher-directed reading instruction on student achievement in the subject of reading.

The results of the data analysis for the first research question led the researcher to infer a relationship between the amounts of time students spent using the *ReadAbout* software system and reading achievement, as demonstrated in scale scores on the third and fourth grade TAKS reading test. The amount of time students spent on the program did prove to have an impact on achievement.

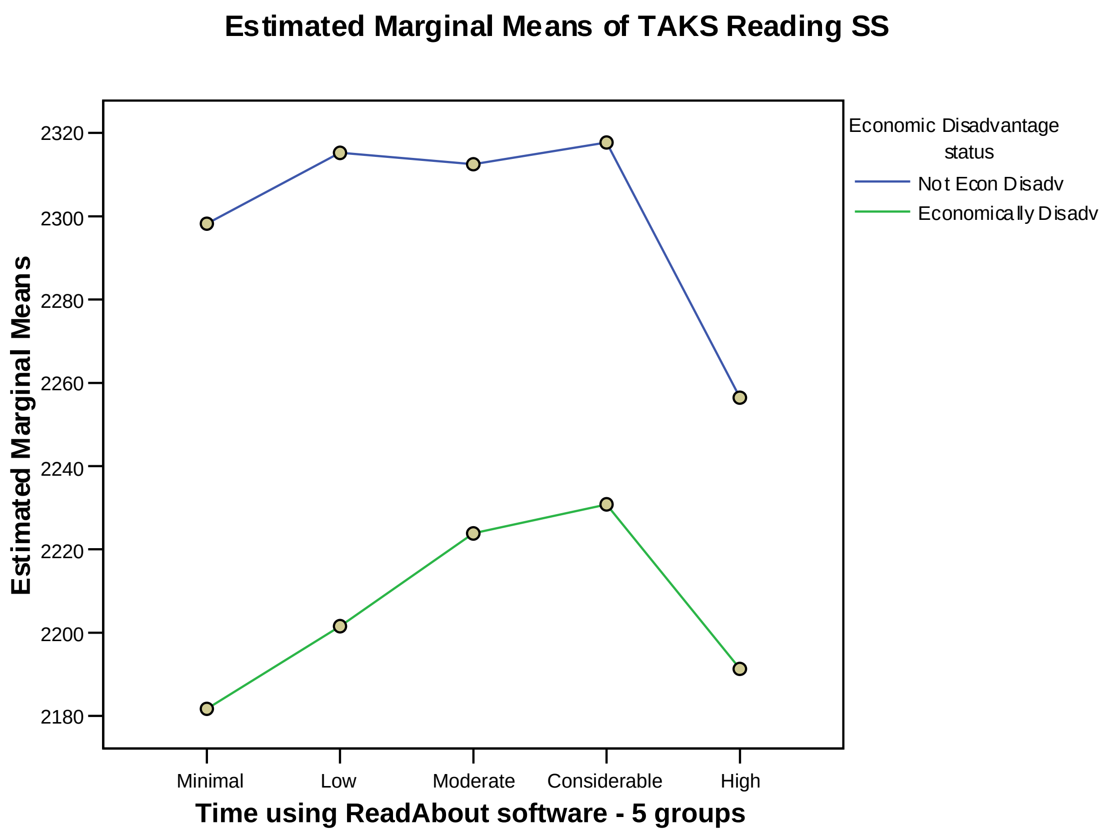

Figure 4.2. Results of Analysis of Variance (ANOVA) Test for Interaction Between Student Usage of the *ReadAbout* Software Program, Student Texas Assessment of Knowledge and Skills (TAKS) Reading Test Scale Score Means, and Student Socio-Economic Status, for Third and Fourth Grade Students Who Took the TAKS Reading Test in Spring 2008 in the Elementary Schools of the Comal Independent School District, Texas.

The results of the data analysis for the second research question led the researcher to infer there was a relationship between usage of the *ReadAbout* program and student gender, as well as usage of the *ReadAbout* program and student socio-economic status. However, the amounts of time students from each sub-group spent on the program did not prove to have a significant impact on achievement, and thus, no overall usage and achievement relationship concerning either gender or socio-economic status may be inferred.

The data also indicated a relationship between usage of the *ReadAbout* program and the students' primary language of learning. Furthermore, the amounts of time that students from each sub-group spent on the program also suggested there was a relationship with reading achievement. Limited English Proficient (LEP) students in the "high usage" category did outperform their non-LEP peers within the same usage category, recording a mean scale score that was 30 points higher. Thus, a relationship between the reading achievement of LEP students in the "high usage" category may be inferred, albeit with caution, due the small number of students in this subpopulation.

Chapter V will discuss the conclusions that may be drawn from these results.

CHAPTER V

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

Chapter V contains a summary of the research findings, implications for practice, recommendations for further study, and conclusions that may be drawn. It is divided into four sections. Section one provides a general overview of the Record of Study and a summary of the findings. The goal, the research questions, the population of study, and the procedures are each briefly restated for organizational purposes. Section two outlines the implications for practice for educational leaders. Section three provides recommendations for further study. Section four contains concluding thoughts for this Record of Study based upon the research that was conducted and analysis of the data.

Overview of the Study

The goal of the researcher was to determine if there was a relationship between the amount of time third and fourth grade students spent using the *ReadAbout* software program and their reading achievement, as demonstrated on the Texas Assessment of Knowledge and Skills (TAKS) reading test, and to also determine whether use of the software was significantly more effective for some subpopulations of students than others. The efficacy of the software was to be determined based upon whether it produced positive results in students' reading achievement, thus making it an effective investment for the Comal Independent School District's instructional resources. The following two questions were used to guide this research:

1. Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008

school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported in student records at Comal Independent School District, Texas?

2. Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008 school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported for selected student demographic variables in student records at Comal Independent School District, Texas?

The population of third and fourth grade students who comprised the data set for the study was from each of the nine elementary schools of the Comal Independent School District, and the specific purpose of the research was to determine if there was a correlation between the amounts of time the students spent using the *ReadAbout* software system and their success rate on a common standardized achievement test.

A total of 585 third graders and 792 fourth graders were registered as *ReadAbout* users in the Comal Independent School District during the 2007-2008 school year. Data including students' gender, grade level, ethnicity, primary language of learning, and socio-economic status were collected using information systems provided by the Texas Education Agency. The District's *ReadAbout* database provided records on student usage. This data were combined into a single Microsoft Excel spreadsheet, and in order to maintain confidentiality, the students were each assigned an identification number associated with their home campus and grade level. For the first research question, in order to categorize student time spent using the software for the purpose of the research, five categories were created: “minimal” usage, meaning less than 138 minutes, “low” usage, meaning between 139-369 minutes, “moderate” usage, meaning between 371-644 minutes, “considerable” usage, meaning between 645-998 minutes, and “high” usage, meaning between 1000-3519 minutes.

For the second research question, the subjects from the third and fourth grades were grouped together, and usage was categorized into quintiles of roughly the same number of members in order to allow for a more equal comparison. The Texas Education Agency’s TAKS reading test was used as a common, standardized measurement of student achievement, and the students’ scale scores on the assessment were entered into the appropriate place on the spreadsheet. Analysis of Variance (ANOVA) tests were utilized for the purpose of making statistical comparisons between the different subpopulation groups. The software tool used for this analysis was version 11/5/01 of the Statistical Package for Social Studies (SPSS).

Findings

The analysis of the data generated by this work corresponds with the findings of some studies cited in the review of the literature; but in other cases, these findings are not consistent with existing literature. Viadero (2007) has broadly called into question the scientific methodology of early meta-analyses on this subject, which often did not link the amount of time students spent using computer software systems with their achievement, making comparisons of research findings difficult. Despite this challenge, the findings for each research question will be compared and contrasted in this section with the knowledge base on this subject.

Research Question 1

Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008 school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported in student records at Comal Independent School District, Texas?

The results of this study indicated that that was a statistically significant relationship between the amounts of time that both third graders and fourth graders spent using the *ReadAbout* software system and their reading achievement, as demonstrated on the 2008 TAKS reading test. For the 585 third graders who comprised the population of the study, students whose usage was characterized as “low” and “high” had a mean scale score on the TAKS reading test of 2227 and 2244, respectively, which is statistically different than the mean scale score of 2323 for students whose usage fell within the “considerable” range.

The 792 fourth graders who comprised the population for the study also demonstrated a statistically significant difference in reading achievement. Students whose usage was characterized as “considerable” and “high” recorded mean TAKS reading test scale scores of 2222 and 2224, respectively, and these scores were statistically different than the mean scale score of 2296 for those students identified as “low” users. In other words, students who generally spent a total of between two and six hours on *ReadAbout* before taking the TAKS reading tests did significantly better on it than did students who spent 11 hours or more on *ReadAbout.*

That “low” fourth grade users scored significantly higher than “considerable” and “high” fourth grade users is inconsistent with the conclusion drawn from a study that reported that the more students used technology, the higher they achieved (Mann et al., 1999), and it also does not correspond with research that demonstrated that the more students read, the better readers they became (Pinnell et al., 1995).

The finding from this research study, which suggests a possible usage threshold, past which time spent on *ReadAbout* is either ineffective or even detrimental, is significant. It contradicts the implications of a particular study cited in the review of the literature in which students that spent 200 minutes per week using computer-assisted reading instruction outperformed students who did not receive the same exposure to technology (Barker & Torgesen, 1995).

Research Question 2

Is there a relationship between the amount of time third and fourth grade students utilized the *ReadAbout* software program during the 2007-2008 school year and their scale scores on the 2008 third and fourth grade TAKS reading test as reported for selected student demographic variables in student records at Comal Independent School District, Texas?

For the second research question, the researcher attempted to determine if there was a difference in achievement between male and female students, limited English proficient (LEP) and Non-LEP students and economically disadvantaged and non-economically disadvantaged students who used the *ReadAbout* software program for similar amounts of time.

Data analysis conducted through the use of a one-way ANOVA test revealed that when gender and usage were taken into consideration and compared to scale scores on the TAKS reading test, there was no statistical significance between the scores of boys and girls who belonged to the same usage groups. Neither group demonstrated a higher level of reading achievement than their opposite-gender peers.

The students' primary language of learning was also a subject for analysis in the second research question. The researcher attempted to determine if *ReadAbout* had a greater impact on the reading achievement of LEP students compared to their non-LEP peers within the same usage group quintiles. The analysis of the data for these two groups revealed that there was a statistically significant difference when the students' primary language of learning and usage were taken into consideration, and thus, the decision was made to reject the null hypothesis of no difference. Consequently, a Scheffe Post Hoc test was run in order to determine which user group quintile contained the mean scale scores on the TAKS reading test that were different in a statistically significant way. The LEP students in the "high" usage group had a mean scale score of 2256, compared to the mean scale score of 2226 for their non-LEP peers.

The researcher also controlled for socio-economic status (SES) in the second research question in order to determine if within groups of students who used the *ReadAbout* software program for similar amounts of time, there was a difference between low-SES students and their peers whose SES status is not considered low. When SES was the sole basis for comparison, the significance level was .000, meaning there was a significant difference between the scale scores of low-SES students and those who did not qualify as low-SES. However, when SES and usage were considered together through the use of a two-way ANOVA test, a significance of .400 prompted the decision to fail to reject the null hypothesis of no difference. In other words, low-SES students did not demonstrate greater achievement as reported in the 2008 TAKS reading test than their peers within the same usage group quintiles who did not qualify as low-SES.

In fact, the mean scale scores of low-SES students in the “moderate,” “considerable,” and “high” usage groups were still lower than the mean scale scores of the non-economically disadvantaged students in the “minimal” and “low” usage categories, meaning that more than 371 minutes of *ReadAbout* usage did not help the low-SES students compensate for achievement differences between themselves and students who are not considered low-SES. In other words, the students who were not considered economically disadvantaged and used the program for less than six hours still outperformed the economically disadvantaged students who used the program for more than six hours.

A noteworthy finding for this SES subpopulation is the similarity of mean scale scores for both groups of students in each of the five usage group categories. The lowest means for both groups are found in the “minimal” usage quintile, and as shown in Figure 4.2, the line graph depicts each SES group very similarly, with the groups paralleling each other. The more minutes each group spent using the *ReadAbout* system, the higher the mean scale score for the groups within the “low,” “moderate,” and “considerable” quintiles. The correlation between usage and achievement for these four *ReadAbout* usage groups corresponds with meta-analyses which assessed the efficacy of first-generation reading software programs (Bangert-Drowns et al., 1985; Davidson et al., 1996; Kulik, 1994; Kulik & Kulik, 1991).

However, there was a sizeable decrease in the mean scale score for both "high" user SES groups. In other words, for students in the top 20% in terms of minutes spent utilizing the *ReadAbout* software system, the mean scale score for economically disadvantaged students in the "considerable" usage group was 2231, compared to 2191 for students in the same SES category in the "high" usage group – a difference of 40 points. Similarly, the mean scale score for non-economically disadvantaged students in the "considerable" usage group was 2318, compared to 2256 for students in the same SES category in the "high" usage group – a difference of 62 points. In fact, economically disadvantaged "high" usage students had a mean scale score on the TAKS reading test that was only nine points higher than their economically disadvantaged peers in the "minimal" usage group. Non-economically disadvantaged "high" users had a mean scale score that was 40 points below the non-economically disadvantaged "minimal" users. This finding again suggests the possibility of a threshold of effectiveness, past which time spent using the *ReadAbout* software system is not beneficial, and is possibly even detrimental.

Some researchers assert that the use of technology with "at-risk" students encourages them to connect with their learning in meaningful ways and has the potential to make them successful (Cradler et al., 2002; Roschelle et al., 2000). Though the group was relatively small and caution should be used in making broad generalizations, LEP students in the “high” usage category outperformed their non-LEP peers.

Research on technology use by “at-risk” students has shown that positive outcomes, including higher achievement, have been found when computer-assisted instruction is used in the context of engaging, authentic lessons, including ones during which the students are encouraged to interact with one another (Dunkel, 1990; Merino et al., 1990).

However, students interface with the *ReadAbout* software program independently, in isolation of both their teachers and their peers. By its nature as an individualized supplement to teacher-directed reading instruction, *ReadAbout* does not match the descriptors for effectiveness established by this research. Perhaps for this reason, most “at-risk” usage groups, including LEP and economically disadvantaged students, did not perform at levels that could be considered statistically significant. Research that substantiates the claim of non- and adverse effects on achievement for independent computer work in lieu of collaborative, constructivist learning exists (Lou et al., 2001; Roschelle et al., 2000).

In other cases, this research directly contradicts existing information on the subject. For example, the third graders in the “low” and “high” *ReadAbout* usage categories recorded mean scores on the TAKS reading test that were statistically the same. The fourth grade students in the “considerable” and “high” usage groups, who roughly spent between 11 and as many as 58 hours on *ReadAbout*, had virtually the same mean TAKS reading test scale score, at 2222 and 2224, respectively. However, these means were considered statistically different than the mean scale score of “low” usage students who only spent roughly two to six hours on *ReadAbout*, but recorded a mean scale score of 2296, more than 70 points *higher* than their “considerable” and “high” use fourth grade peers.

These findings do not correspond with studies that have shown a direct relationship between the time that students spend on the computer and their overall achievement (Mann et al., 1999), nor with research specific to the amount of time that children read and their performance on reading achievement tests (Pinnell et al., 1995).

Similarly, conclusions drawn from meta-analyses conducted by the National Institute of Child Health and Development (NICHD), which correlated the amount of time children read with their overall achievement in reading, are not substantiated by this research, though it should be stated that the NICHD cautioned that the relationship between reading and achievement should not necessarily be considered causal because it is possible that students who read well tend to choose to read more often (NICHD, 2000).

Implications for Practice

The purpose of this research was practical in nature. The researcher intended to determine whether third and fourth grade students’ usage of the *ReadAbout* software system during the 2007-2008 school year had an impact on their achievement, as reported through the Texas Assessment of Knowledge and Skills (TAKS) reading test administered in Spring 2008.

According to findings from the first research question, a relationship between *ReadAbout* usage and reading achievement may be inferred for both the third graders and the fourth graders. The amounts of time students in both grade levels spent using the program did impact their performance, though it is unclear whether the relationship is necessarily causal. Data analysis related to the second research question, exploring the relationship of usage and achievement for males and females, Limited English Proficient (LEP) and non-LEP students and economically-disadvantaged and non-economically disadvantaged students presents minimal evidence of the program being particularly helpful for any of these subpopulations across the five designated usage categories, although a very small group of 13 LEP students in the “high usage” category did outperform their non-LEP peers who had used *ReadAbout* for similar amounts of time, recording a mean scale score on the TAKS reading test that was 30 points higher. This is statistically significant if one excuses the population size and is cautious in making programmatic decisions based upon such a small sample.

The following are implications for practice based upon the findings of the research:

1. Ambiguities in the data have been uncovered, and they require careful consideration and further study. For example, it cannot be assumed that the more a student uses *ReadAbout*, the higher he or she will score on the TAKS reading test. For example, the 158 third graders who used the program between 645-998 minutes, thus designated “considerable” users, had a mean scale score that was 79 points higher than the 43 third graders in the 1000-3519 minute “high usage” category. This difference is

considered statistically significant. The means for the TAKS scale scores for third graders in the "low usage" and "high usage" categories were considered statistically the same, at 2228 and 2244, respectively, though low users spent no more than roughly six hours using *ReadAbout*, and "high" users spent more than 16 hours using it. In the fourth grade, students who were considered "minimal," "low," or "moderate" users had mean scale scores that were higher than the mean scale scores of the students who belonged to the "considerable" and "high" usage categories. These data suggest that there is possibly a threshold of effectiveness for *ReadAbout* usage, and that some students might have actually spent too much time on the software. For example, it is possible that students who spent less time using the program did not necessarily spend less time reading, but rather spent more time receiving direct reading instruction from their teachers.

2. Students who were not considered of low socio-economic status consistently outperformed their low-SES peers in each of the usage groups; however, the margin of the difference for mean scale scores decreased the more the students used the program. This is depicted in Table 4.19. Though it did not prove to be statistically significant, this observation is still noteworthy. Economically disadvantaged students who on average spent more than 20 minutes per week on *ReadAbout* scored higher on the TAKS reading test when compared to their non-economically disadvantaged peers than economically disadvantaged students who spent 10 minutes or fewer on the program when compared to their non-economically disadvantaged peers. For "high" usage category students from both socio-economic categories who each week averaged Scholastic, Incorporated's recommended 40 minutes or more on *ReadAbout*, the margin of difference between the

mean scale scores was the lowest. These data imply that when economically disadvantaged students spend moderate to considerable amounts of time on *ReadAbout*, positive outcomes can be expected.

3. A belief exists among some educators that male students tend to prefer non-fiction passages, while female students tend to prefer works of fiction. Consequently, one might expect that because *ReadAbout* passages are exclusively categorized as non-fiction, male students who used the program would have outperformed their female peers on the TAKS reading test. This, however, was generally not the case, and the researcher made the decision to fail to reject the null hypothesis of no difference when gender and usage were paired and considered as factors that might have affected achievement. As depicted in Table 4.11, the female students recorded an overall mean scale score that was 11 points higher than the males; and when further analyzed by usage category, the difference in female mean scale scores was considerably higher in the "minimal," "moderate," and "considerable" usage categories. The males did outperform the females slightly in the "low" and "high" usage categories, but their mean scale scores were only four and seven points higher than the females, respectively.

Recommendations for Further Study

The review of the literature on technology use in the classroom and reading instruction revealed that there is a need for additional studies that determines its impact on student achievement and contributes to the widespread implementation of "best practices" for teaching students to become better readers. The research associated with this Record of Study has been conducted in an attempt to understand the way a group of

1,377 students from nine elementary campuses in the Comal Independent School District performed on a standardized reading test after using a supplemental software program for a period of approximately six months during one school year.

Recommendations for further research related to the topic of computer-assisted reading instruction follow:

1. Research is needed to determine how students perform on reading achievement tests after a prolonged period of *ReadAbout* usage. For example, a longitudinal study that tracked these third grade students' use of the program during their fourth and fifth grade years and their performance on the fourth and fifth grade TAKS reading tests in 2009 and 2010 could help formulate a clearer understanding of the impact of the *ReadAbout* software system over time.

2. Fifth grade students in the Comal Independent School District also used the *ReadAbout* software system during the 2007-2008 school year as a supplement to their reading instruction; but at that time, not all of the elementary schools served fifth graders. In an attempt to control for slight variations in implementation plans among the schools, data on their usage and performance were not included as part of this Record of Study. Additional data could prove useful in determining the overall impact of *ReadAbout* usage on student achievement.

3. For the purpose of this Record of Study, scale scores on the TAKS reading test were chosen as a standardized measure of reading achievement. The range of scale scores collected in this research ranged from 1313 to 2616, with scores of 2100 or greater representing the level at which students met state standards and scores of 2400 or

greater representing the level at which students achieved “commended” status for their performance. Yet, it is also possible to consider the impact of *ReadAbout* usage in incremental, “value added” terms. Lexile levels, which represent the level of difficulty for material students are able to read and comprehend independently, are continually assessed based upon students’ responses to comprehension questions. These levels readily appear on student profile reports but were not used for the purpose of this research. A repetition of the study that analyzes the impact of *ReadAbout* usage on reading achievement in value added terms of the growth of the students as reported in their change in Lexile levels should also be conducted. It could possibly reveal a different set of relationships between student usage and reading achievement than the TAKS scale scores, as the determinant of achievement for this Record of Study, are able to do.

4. Research should be conducted that compares the reading achievement of students who used the *ReadAbout* software system with the reading achievement of students who did not. Though this Record of Study surveyed a sizable population and data representing over 1,300 students were included, that figure is fewer than half of the Comal Independent School District’s total number of third and fourth graders enrolled during the 2007-2008 school year. Because of the limited number of available licenses, only students who needed additional support received access, meaning an in-district achievement comparison of the test group and the control group would have been biased. However, the TAKS reading test scale scores of students with similar demographic

characteristics from a nearby school district that does not use *ReadAbout* could be used for comparison.

5. The group of Limited-English Proficient (LEP) students who outperformed their non-LEP peers within the “high *ReadAbout* usage” category requires further study and consideration. The LEP population within this group was very small, and implications for practice must be made with caution. A more sizeable population for comparison would lend credibility to the conclusions tentatively drawn from this research.

6. Qualitative research on computer-assisted instruction in general and on the *ReadAbout* software system, specifically, is needed. As the researcher collected the data from the nine different schools and noticed that usage differed widely among them, questions on implementation practices arose. These could not be addressed in this Record of Study due to the limitations of quantitative research. The learning needs of individual students stretch teachers’ time, and it is assumed that *ReadAbout* sessions are scheduled as an additional way to reinforce concepts for students when their teacher is occupied with other students. Researchers should interview teachers and administrators in schools that use *ReadAbout* in order to determine their thoughts and feelings on the role of supplemental instructional technology and their confidence in its use. The philosophy and thought process behind educators’ comprehensive plans for reading instruction could influence the ways *ReadAbout* is used and thus explain different usage patterns between similar groups of students at different schools. These qualitative data

have the potential to add valuable insight to an evaluation of *ReadAbout*, and thus, they too, should be collected and interpreted.

Conclusions

The purpose of this Record of Study was to determine the relationship of student use of Scholastic, Incorporated's *ReadAbout* software system on Texas Assessment of Academic Skills (TAKS) reading test scores as reported in student records of third and fourth grade students in the Comal Independent School District. According to the findings associated with the first research question, a relationship may be inferred because the amount of time students in each of the grade levels spent using the program did impact their achievement.

For the second research question, in which the program's effectiveness for student subpopulations was examined, no significant relationship was associated with students' gender or socio-economic status, though when students' primary language of learning was considered, "high usage" Spanish-speaking students did outperform "high usage" English-speaking students. This finding corresponds with research on how the use of technology motivates "at-risk" students and helps them achieve (Dunkel, 1990; Gee, 2003; Roschelle et al., 2000; Warschauer et al., 2004). However, caution should be used when making programmatic decisions based upon this data because of the small size of the "high usage" Spanish-speaking population.

As supplemental, computer-assisted instruction gains popularity, as a larger and larger share of school budgets is spent on technology, and as these software systems continue to evolve and presumably improve over time, educators and educational researchers must be prudent, even cautious in their use and evaluation of them (Ferdig, 2006). The five-year research initiative currently being supported by a $50 million grant from the John D. and Catherine T. MacArthur Foundation should infuse the body of literature with updated information on this subject (MacArthur Foundation, 2006).

Even as data on the impact of technology such as the *ReadAbout* software system continue to be generated and as some of these data indicate promising signs for computer-assisted technology, there is still much work in this field to be done. Comprehensive quantitative and qualitative research is needed in order to guide software developers in their creation of effective, new innovations and to also guide school administrators in their selection of the instructional software systems that will produce the greatest achievement gains for our students.

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CERTIFICATIONS

Standard Principal, Grades EC-12
Standard Elementary Self-Contained, Grades 1-8
Provisional Secondary English, Grades 6-12 (life)
Provisional Secondary English Language Arts, Grades 6-12 (life)
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EXPERIENCE

2006-Present	Principal, Bill Brown Elementary School Comal Independent School District, New Braunfels, Texas
2003-2006	Assistant Principal, Cambridge Elementary School Alamo Heights Independent School District, San Antonio, Texas
2002-2003	Teacher, Fourth Grade, Crockett Elementary School, San Marcos Consolidated Independent School District, San Marcos, Texas
2000-2002	Assistant Principal, Frank Porter Graham Elementary School Chapel Hill-Carrboro City School System, Chapel Hill, North Carolina
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